

Midterm 1 Examination
March 07, 2022, 11:30 am – 12:30 pm

Course Code: CS3001	Course Name: Computer Networks
Instructor Name: Dr. Farrukh Salim , Dr. Aqsa Aslam, Mr. Shoaib Raza and Ms. Eman Shahid	
Student Roll No:	Section:

Instructions:

- Return the question paper. Do not write anything on question paper, except your Roll # & Section #.
- Read each question completely before answering it. There are **5 questions and 2 pages**.
- In case of any ambiguity, you may make assumptions. However, your assumptions should not contradict any statement in the question paper.
- All the answers must be solved according to the sequence given in the question paper.
- This paper is subjective. Write the answers only on answer sheet.

Time: 60 minutes.**Max Points:** 50**Question 1:**

[4 + 2 + 4 = 10 points]

Consider the scenario shown in Figure 01, in which Origin server is connected to a router by a 100 Mbps link with a 50ms propagation delay. That router in turn is connected to another router over a 25Mbps link with a 200ms propagation delay. 1 Gbps link connects a host and a cache (when present) to a router; this link, being a local area network has no propagation delay. All packets in the network are 20,000 bits long.

- (a) What is the end-to-end delay from when a packet is transmitted by the server to when it is received by the client? In this case, we assume there are no caches, there is no queuing delay at the routers, and the packet processing delays at routers and nodes are all zero.

Solution:

If all packets are 20,000 bits long →
 it takes 200 usec to send the packet over the 100Mbps link (L/R_1)
 800 usec to send over the 25Mbps link (L/R_2).
 20 usec to send over the 1Gbps link (L/R_3).
 Sum of the three-link transmission is 1020 usec
 Sum of all propagation is 250ms
 Thus, the total end-to-end delay is 251.02 msec.

- (b) What is the maximum rate at which the server can deliver data to a single client if we assume no other clients are making requests? Here we assume that client hosts send requests for files directly to the server (caches are not used or off in this case).

Solution: Server send at the max of the bottleneck link 25Mbps.

- (c) What is the average end-to-end delay for the case that 60% of the requests can be satisfied by the local cache?

Solution:

40% of the requests have a delay of 251.02 msec
 60% of the requests have a delay of 20 usec.
 So the average delay is $(100.408\text{ms} + 12\text{usec}) = 100.41 \text{ msec}$.

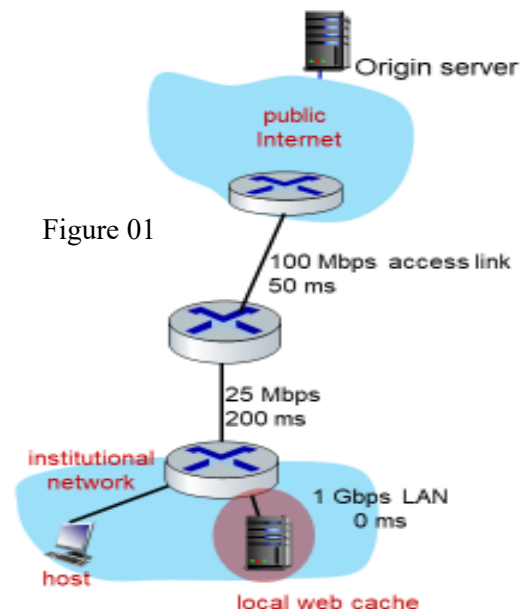


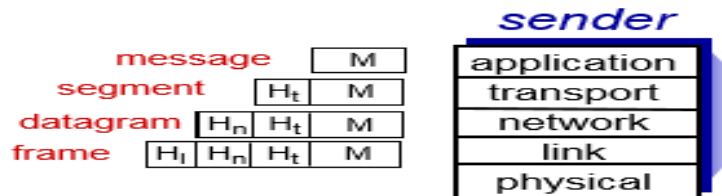
Figure 01

Question 2:

[2 * 5 = 10 points]

Suppose an application is running on the host as shown in Figure 01, wants to send a message to Origin server connected to Public Internet.

(a) Show how is this message processed at each TCP/IP layers at the sender?

Solution:

(b) How is this message delivered to only one application process at the receiver? Explain.

Solution:

Transport layer adds Port number and IP address. Port number ensures delivery from the source process to destination process using socket.

Question 3:

[4 * 2.5 = 10 points]

Suppose you click on a URL <http://www.fastnuces.edu.pk> to obtain a webpage. The webpage is composed of five different objects. How many Round Trip Time (RTT) are needed to download the webpage using:

- (a) Non Persistent HTTP
- (b) Persistent HTTP
- (c) If the size of one or two objects is large, it will cause Head of Line blocking (HOL). How HTTP/2 mitigates this issue?
- (d) Which transport layer service will be used to download the webpage?

Solution:

Once the IP address is known, RTT₀ elapses to set up the TCP connection and another RTT₀ elapses to request and receive the Web object.

(a) non persistent HTTP

At most one object is sent over a TCP connection.

[1 RTT (TCP handshaking) + 1 RTT (HTTP request/response)] * 6 objects (1 Web page + 5 objects) = 12 RTT

(b) persistent HTTP

Multiple objects can be sent over single TCP connection between client and server. The browser first waits to receive a HTTP response from the server before issuing a new HTTP request.

1 RTT (TCP handshaking) + 1 RTT (HTTP request/response) * 6 objects = 7 RTT

(c) Using HTTP 2, which makes the chunks of large objects (slicing) and perform interleaving to deliver the objects.

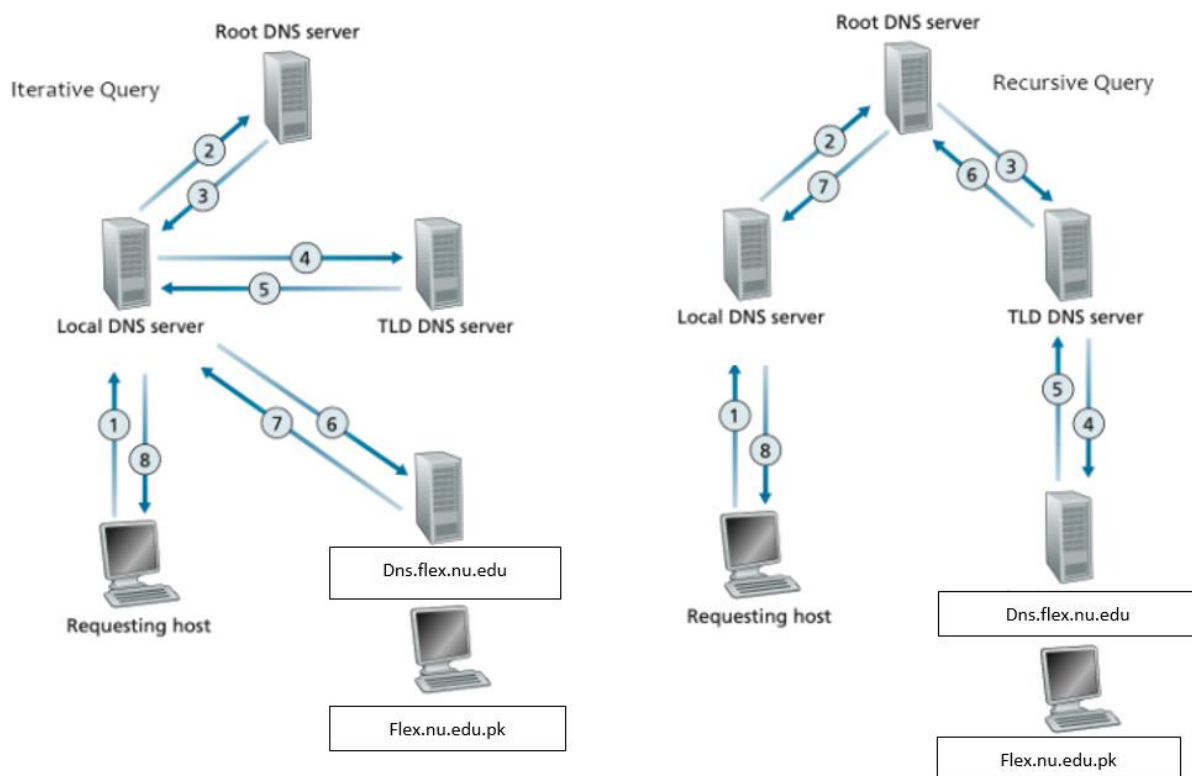
(d) TCP

Question 4:

[10 points]

Suppose your CN instructor has updated marks on Flex <https://flex.nu.edu.pk/>. Assume there is no Web cache server available on our institutional network. Which two techniques will be used by local DNS server to resolve the address of the webpage? Explain this with the help of labelled diagrams.

Solution:



Question 5:

[4 * 2.5 = 10 points]

Consider the scenario shown in Figure 02 in which a client sends an HTTP request to a web server. The path from the client to the web server has three links, each with a specified transmission rate of link 1 = 1000 Kbps, link 2 = 100 Mbps, and link 3 = 1000 Mbps. Assume the length of a packet is 80KB.

(a) What is the maximum throughput achievable between a client and a web server?

Solution: The maximum throughput achievable between sender and receiver is 1000Kbps.

(b) What information in the packet does the router use to determine the link onto which the packet is forwarded?

Solution:

The router uses the destination IP address in the packet to determine the outgoing link.

(c) List the delay components in the end-to-end delay.

Solution:

The delay components are transmission delay, propagation delay, processing delay and queuing delay

(d) What is the transmission delay at link 2?

Solution: The transmission delay at link 2 is 8×10^{-4} sec.

