National University of Computer and Emerging Sciences
Lahore Campus

Computer Networks (CS3001)

Date: February 23rd 2026

Course Instructor(s)

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Sessional-I Exam

Total Time: 1 Hour(s)

Total Marks: 45

Total Questions: 5

22L3000 _____ _____

Roll No Section Student Signature

Instruction/Notes:
- Attempt all questions on the provided separate answer sheet.
- Clearly write corresponding question number and part number at the top center of the answer sheet with a thick pen / marker before starting a new question / answer.
- In case you have used rough sheets, they should **NOT** be attached to the answer sheet.

CLO 1 (Q1 to Q2): **Describe** utilization of network protocol concepts vis-a-vis OSI and TCP/IP stack. **[10 + 10 = 20 Marks]**

Q1 (a): A source host sends a message M = 600,000 bits to a destination host through two intermediate routers (a total of 3 hops). Each link has a transmission rate of R = 10 Mbps (where 1 M = 10^6.) The propagation delay for each link is 10 ms (where 1 ms = 10^{-3}.) The message is segmented into 300 packets by the source host, each of length L = 2,000 bits. Assuming store-and-forward switching and zero processing or queuing delays, what is the total end-to-end delay to deliver the entire message to the destination? **[5 Marks]**

(b): For this part, assume that the message M in part (a) is not segmented into smaller packets but is instead sent as one big packet of length L = 600,000 bits by the source host. Would the total delay for this packet to reach the destination: remain the same, increase or decrease compared to your answer in part (a)? Justify your answer. (Assume everything else is the same as in part (a).) **[5 Marks]**

Q2: A client downloads 2000 bytes of App layer data from a server using the TCP/IP Layered Model. Assume:
- Application layer adds no header
- Transport Layer and Network Layer add a 20-byte header each
- Link Layer adds a total of 22 bytes (header + trailer)
- The entire data fits into one transport layer segment
- The client and server are connected via one switch and one router only

Answer the following questions: **[1 * 10 Marks]**

i) What is the total size of the transport layer segment payload?
ii) What is the total size of the transport layer segment?
iii) What is the total size of the network layer datagram?
iv) What is the total size of the link layer frame?
v) What is the total overhead percentage?

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vi) Which layer is responsible for enabling process to process communication?
vii) Which layer is responsible for host-to-host delivery?
viii) Which layer is responsible for local delivery?
ix) Which layer(s) are not visible to the switch?
x) Which layer(s) are not visible to the router?

CLO 2 (**Q3 to Q5**): **Demonstrate** the basics of network concepts using state-of-the-art network tools/techniques. **[14 + 5 + 6 = 25 Marks]**

Q3 (a): A client retrieves a Web page consisting of one base HTML file and 6 referenced objects, whereas the propagation delay = 30 ms, thus 1 RTT = 60 ms. DNS lookup requires two DNS servers and iterative queries are used, with each DNS query taking 1 RTT (i.e. total time for one DNS query including request & response.) The base object size is 120K Bytes, while each referenced object is 10 K Bytes & the link transmission rate R = 10 Mbps. Compute the total delay to retrieve the entire webpage for the following scenarios: **[2 * 3 + 4 = 10 Marks]**

i) Non-persistent HTTP with no parallel connections
ii) Persistent HTTP without pipelining (no parallel connections)
iii) Persistent HTTP with pipelining (no parallel connections)
iv) Non-persistent HTTP with maximum three parallel connections possible (no pipelining)

Q3 (b): A client is connected to a local proxy cache, which in turn is connected to an origin server with the following characteristics:

- RTT_{cl} = 10 ms (i.e. Round-Trip Time between the client & the local cache)
- RTT_{ls} = 80 ms (i.e. Round-Trip Time between the local cache & the origin server)
- T_{trans} = 30 ms (i.e. Time to transmit the object)
- Ignore any other delays

Assume that persistent TCP connections are already established to both the cache and the server. The client requests an object that is already stored in the local proxy cache. Calculate the total response time for the following two scenarios: **[2 + 2 = 4 Marks]**

i) Scenario A: The Object in the cache is fresh.
ii) Scenario B: The Object in the cache is stale.

Q4: An email of 20 KB is sent from a client to a mail server via SMTP. The propagation delay = 20 ms, link bandwidth = 2 Mbps, and SMTP requires 4 round-trip command sequences (HELO, MAIL FROM, RCPT TO, DATA/QUIT). Compute approximate total time to send the email (ignoring server processing). **[5 Marks]**

Q5: A user requests www.university.edu.pk. The local DNS server caches nothing. The delays are:

- Local Host to Local DNS: 2 ms (One way).
- Local DNS to Root Server: 40 ms (RTT).
- Local DNS to .pk TLD Server: 35 ms (RTT).
- Local DNS to .edu.pk Authoritative Server: 20 ms (RTT).
- Local DNS to university.edu.pk Server: 15 ms (RTT).

The DNS resolution is Iterative. The RTT between the client and the web server is 50 ms. Assume a new TCP connection is established and requires one RTT for the TCP handshake and one RTT for the HTTP request/response. Calculate the total time from clicking the link to receiving the initial HTTP response, assuming the Local DNS server must contact Root, then TLD, then Authoritative. The local DNS server must also query the final authoritative server for university.edu.pk to obtain the IP address. **[6 Marks]**