Computer Networks (CS3001) — Sessional-I Exam

Date: February 27th, 2025
Course Instructor(s)

Total Time: 1 Hour
Total Marks: 40
Total Questions: 05

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Semester: Spring-2025
Campus: Lahore
Dept: Computer Science

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Instruction/Notes:
- Attempt all questions on the provided separate answer sheet (including Q1 MCQs) in sequence and attempt all parts of the same question together.
- Return the question paper with the answer sheet to the examiner at the end of the exam. (It should not be stapled to the answer sheet.)
- Clearly write the 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 & Q2): Describe utilization of network protocol concepts vis-a-vis OSI and TCP/IP stack.

Q1: Answer the following multiple-choice questions by writing the correct option in the answer sheet: Any _cutting and overwriting is not allowed and will be awarded zero marks. Also any answers on the question sheet are not allowed and will be not be marked._   **[1 * 6 = 6 Marks]**

1.1. Which of the following types of network delay is caused by the time it takes to push all bits of a packet into the link?

A. Transmission   B. Propagation   C. Queuing   D. Processing

1.2. In the HTTP protocol, which connection type keeps the connection open for multiple requests and responses between the client and server?

A. Non-Persistent   B. Persistent   C. Parallel   D. None

1.3. In circuit switching, how many users can be accommodated on a 1Gbps link. Each user requires 50Mbps when active and each user is active 10 percent of the time.

A. 10   B. 20   C. 50   D. 200

$$\frac{1 \times 10^9}{50 \times 10^6} = 20$$

1.4. Consider the following steps related to e-mail in the given sequence; i) Send an e-mail from a mail client to a mail server. ii) Download e-mail headers from the mail box and retrieve emails from the server to a cache. iii) Checking e-mail through a web browser. The application-level protocol used for each step in the above sequence is:

A. HTTP, SMTP, IMAP   B. SMTP, POP, IMAP   C. SMTP, IMAP, HTTP   D. IMAP, SMTP, POP

1.5. As the traffic intensity reaches 1 or above:

A. Propagation delay approaches infinity   B. Propagation delay approaches zero
C. Queuing delay approaches zero   D. Queuing delay approaches infinity

1.6. Which of the following option is completely correct with respect to the client?

A. HTTP is a pull protocol, while SMTP is a push protocol   B. Both HTTP & SMTP are pull protocols
C. HTTP is a push protocol, while SMTP is a pull protocol   D. Both HTTP & SMTP are push protocols

Q2: A multinational company has two data centers in different countries, connected by a dedicated fiber-optic link. The first data center (DC1) is in New York, and the second data center (DC2) is in London, separated by a distance of 5,600 km. The link between them has a bandwidth of 100 Mbps and the signal propagates at 2.5×10^8 m/s in the optical fiber. DC1 wants to send a 200 MB file to DC2 (1 MB = 10^6 Bytes.) To ensure reliability, the file is divided into 10 equal-sized packets. Each packet is sent immediately after the previous one is fully transmitted.
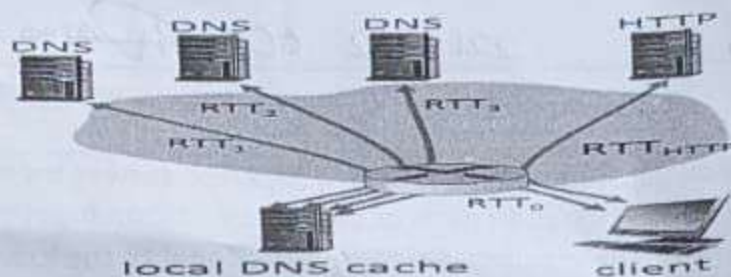
$$[3 + 3 + 2 = 8 \text{ Marks}]$$

(a) Calculate the transmission delay for a single packet?

(b) Calculate the time taken to transmit all the packets?

(c) Calculate the propagation delay of the link?

CLO 2 (Q3 to Q5): Demonstrate the basics of network concepts using state-of-the-art network tools/techniques.

$$[4 * 3 = 12 \text{ Marks}]$$

Q3: Refer to the diagram below:

local DNS cache   client

In your web browser you enter a URL to obtain a Web page. The IP address for the associated URL is not cached, so a DNS lookup is necessary to obtain the IP address. Suppose that 4 DNS servers are visited before your host receives the IP address from DNS. The 1st DNS server visited is the local DNS, with an RTT delay of $RTT_0 = 5$ msecs. The 2nd, 3rd & 4th DNS servers contacted have RTTs of 33, 35 & 4 msecs respectively. Initially, let's suppose that the Web page associated with the link contains exactly one base object consisting of a some HTML text. Suppose the RTT between the local client and the HTTP Web server is $RTT_{HTTP} = 77$ msecs.

(i) Assuming zero transmission time for the HTML object (base file), how much time (in msec) elapses from when the client clicks on the link until the client receives the object? (Assume processing and queuing delays are also zero.)

(ii) Now suppose the HTML object (base file) references 10 very small objects on the same server. Neglecting transmission times, how much time (in msec) elapses from when the client clicks on the link until the base object and all 10 additional referenced objects are received from web server to the client, assuming non-persistent HTTP and no parallel TCP connections and no pipelining? (Assume processing and queuing delays are also zero.)

(iii) Suppose the HTML base object references 10 very small reference objects on the same server but assume that the client is configured to support a maximum of 5 parallel TCP connections with non-persistent HTTP (non pipelining.) Neglecting transmission times, how much time (in msec) elapses from when the client clicks on the link until the base object and all 10 additional referenced objects are received from web server to the client? (Assume processing and queuing delays are also zero.)

(iv) Suppose the HTML base object references 10 very small reference objects on the same server but assume that the client is configured to support a maximum of 5 parallel TCP connections with persistent HTTP (no pipelining.) Neglecting transmission times, how much time (in msec) elapses from when the client clicks on the link until the base object and all 10 additional referenced objects are received from web server to the client? (Assume processing and queuing delays are also zero.)

Q4: Tom wants to send an email to dan@ups.com. The name of the authoritative name server of UPS is "dns.ups.com" with IP address 172.92.68.2 and the name of the mail server of UPS is "post.ups.com" with IP address 172.92.68.21. For this email to be correctly delivered, please answer the following: [2 * 2 = 4 Marks]

a) Write down all the resource records (RR) which should be inserted in the TLD name servers in the format (name, value, type). Ignore TTL in RR.

b) Write down all the RRs which should be inserted in the authoritative name server of UPS in the format (name, type, value). Ignore the TTL in RR.

[10 Marks]

Q5: Answer all parts (a), (b) & (c)

Q5(a): What is the packet at the following layers called: [4]

Layer	Packet Name
Application Layer	Message
Transport Layer	Segment
Network Layer	Datagram
Data Link Layer	Frame

[1 * 3 = 3]

Q5(b):
i) When does an SMTP server act as a client and act as a server?
ii) How does an SMTP server determine the end of the message?
iii) Give an example of the protocol that can be used to retrieve email data from server (email access protocol).

Q5(c): A network with a bandwidth of 10 Mbps (1M = 10^6) can pass only an average of 12,000 frames per minute with each frame carrying an average of 10,000 bits. What is the throughput of this network in Mbps? [3]

12000 frames per min = $\dfrac{200 \text{ frame per sec}}{2}$

$12000 \times$
$\dfrac{}{60}$

$\dfrac{10000 \times 12000}{1}$

$Thray = \dfrac{\text{Total file Size}}{\text{Time required to send that size.}}$

UA $\xrightarrow{SMTP}$ Mail Server

$L/R = \dfrac{10,000 \times 12000 \times \frac{200}{\text{SMTP}}}{12000 \text{ pers}}$

UA

$bih \text{ is sec}$
$= \dfrac{}{10^6 \text{ bit/s}}$

$\dfrac{12000 \text{ pers}}{12000}$

for reques

Server

$\dfrac{L}{R}$