

Roll. No.: _____ Name: _____ Section: _____

CSE232: Computer Networks
Midsem Monsoon 2022 (SOLUTIONS)
Total marks: 32
Duration: 70 mins (10.00 am to 11.10 am)

Instructions:

- (1) Write your Roll. No. and Name on each sheet.
- (2) Read the questions carefully and answer.
- (3) Answer in brief and to the point as much as possible.
- (4) Answer up to 2-point decimal for numerical.

Q.1. Match the columns [7 marks]

Note: You may find multiple matches for the left column; Make sure that there is EXACTLY ONE MATCH from the left column to the right column.

1	TCP concurrent server (blocking sockets)	a	Reduces the data flow between user space and kernel space
2	UDP concurrent server (blocking sockets)	b	Total number of server sockets = 1
3	Transport layer	c	Total number of server sockets = number of concurrent clients
4	Network layer	d	Total number of server sockets = number of concurrent clients + 1
5	“select” system call	e	Guarantees host to host delivery
6	“poll” system call	f	Reinitilaizes the file descriptors after processing so that new I/O events can be monitored
7	“epoll” system call	g	Server only processes the file descriptors for which event has occurred
		h	Guarantees process to process delivery
		i	Total number of server sockets = 2

Ans: 1 _____ , 2 _____ , 3 _____ , 4 _____ , 5 _____ , 6 _____ , 7 _____

Ans: 1 (d) , 2 (b) , 3 (h) , 4 (e) , 5 (f) , 6 (g) , 7 (a) or (g)

Q.2. A sender and a receiver are communicating over a 1Gbps link. The sender sends 100KB packets. The receiver sends 1KB ACKs. Suppose the round trip propagation delay is 10 ms.

(a) What is the throughput if the sender sends 1 packet and waits for an ACK? **[3 marks]**

$$t_{\text{trans_packet}} = (8 \times 100 \times 10^3) / 10^9 = 800 \mu\text{s}, \text{ [1 mark]}$$

$$t_{\text{trans_Ack}} = 8 \times 10^3 / 10^9 = 8 \mu\text{s}, \text{ [1 mark]}$$

$$t_{\text{prop}} = 5 \text{ms} = 5000 \mu\text{s}$$

$$\text{Throughput} = \text{Packet_size} / (t_{\text{trans_packet}} + t_{\text{prop}} + t_{\text{trans_Ack}} + t_{\text{prop}}) \text{ [0.5 mark for equation]}$$

$$= (8 \times 100 \times 10^3) / (10808 \times 10^{-6}) = 74 \text{ Mbps [0.5 mark for correct calculation]}$$

(b) To achieve the maximum throughput, what should be the optimal number of packets that should be sent before waiting for an acknowledgment? **[2 marks]**

To maximize throughput, the optimal number of packets sent before waiting for an ACK indicates the number of bits that should be sent to FILL THE PIPE between the sender and the receiver. This is given by the Bandwidth-Delay Product (BDP). In this context, $\text{BDP} = \text{Bandwidth} \times \text{Round trip time}$. **[1 mark]**

The round trip time refers to the time to send the first bit from the sender and receive the ACK back; i.e., $\text{RTT} = t_{\text{trans_packet}} + t_{\text{prop}} + t_{\text{trans_Ack}} + t_{\text{prop}}$

$$\text{BDP} = 10^9 \times 10.808 \times 10^{-3} = 10.8 \text{ Mbits};$$

$$\text{Num_packets} = 10.8 \text{ Mb} / 800 \text{ Kb} = 13.5 \text{ packets}$$

Consider the answers 13 packets or 14 packets or 13.5 packets [1 mark]

Q.3. Consider two clients C1 and C2 running a UDP application. C1's IP address is **C1**, and the port number is **port1**. C2's IP address is **C2**, and its port address is **port2**. Both the clients talk to a server with IP address **S** on port number **P**. Suppose the UDP packets **P1** from C1 and **P2** from C2 reach S. Mark the one(s) from the following that is(are) true. **[1 mark]**

- The server will demultiplex packets P1 and P2 to two different sockets and two different processes
- The server will demultiplex packets P1 and P2 to the same socket but to different processes
- The server will demultiplex packets P1 and P2 to different sockets but same process
- The server will demultiplex packets P1 and P2 to the same socket and the same process

Ans: d

Q.4. Suppose your laptop is trying to do the resolution for a hostname **xyz.com**. However, no such domain exists. Tell the DNS query and response path for this query. Assuming there is a local DNS server in your network, the cache of the DNS server is empty.

You can assume **iterative resolution**. Answer in this way laptop->*>*> and so on. **[2 marks]**

Ans:

Possible answer 1 (when the laptop uses iterative resolution):

Laptop -> Local DNS Server -> Laptop -> Root Name Server -> Laptop -> Top Level Domain Server -> Laptop

Possible answer 2 (when the local DNS server runs iterative resolution, but the laptop uses recursive resolution):

Laptop -> Local DNS Server -> Root Name Server -> Local DNS Server -> Top Level Domain Server -> Local DNS Server -> Laptop

The following explanation is only for understanding. The justification is not expected for evaluation.

In this case, the domain name does not exist. Hence the TLD server won't provide any authoritative domain name server's IP, rather it responds with an NXDOMAIN error.

The NXDOMAIN is a DNS message type received by the DNS resolver when a request to resolve a domain is sent to the DNS and cannot be resolved to an IP address. An NXDOMAIN error message means that the domain does not exist.

Hence, the laptop (or the Local DNS server) won't send the request to the authoritative domain name server.

Q.5. Mark the one(s) from the following that is(are) false. **[2 marks]**

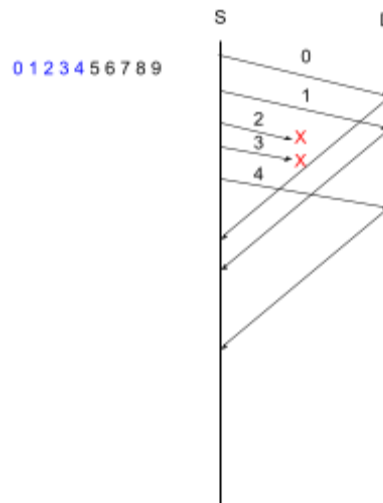
- a. HTTP is a push-based protocol as the client pushes the HTTP request to the server
- b. SMTP is a push-based protocol as an SMTP client pushes the mail to a server
- c. SMTP is a push-based protocol as an SMTP server pushes the mail to a client
- d. In the case of an email application, the receiver's user agent must run a push-based protocol
- e. In the case of an email application, the receiver's user agent must run a pull-based protocol

Ans: a, c, d

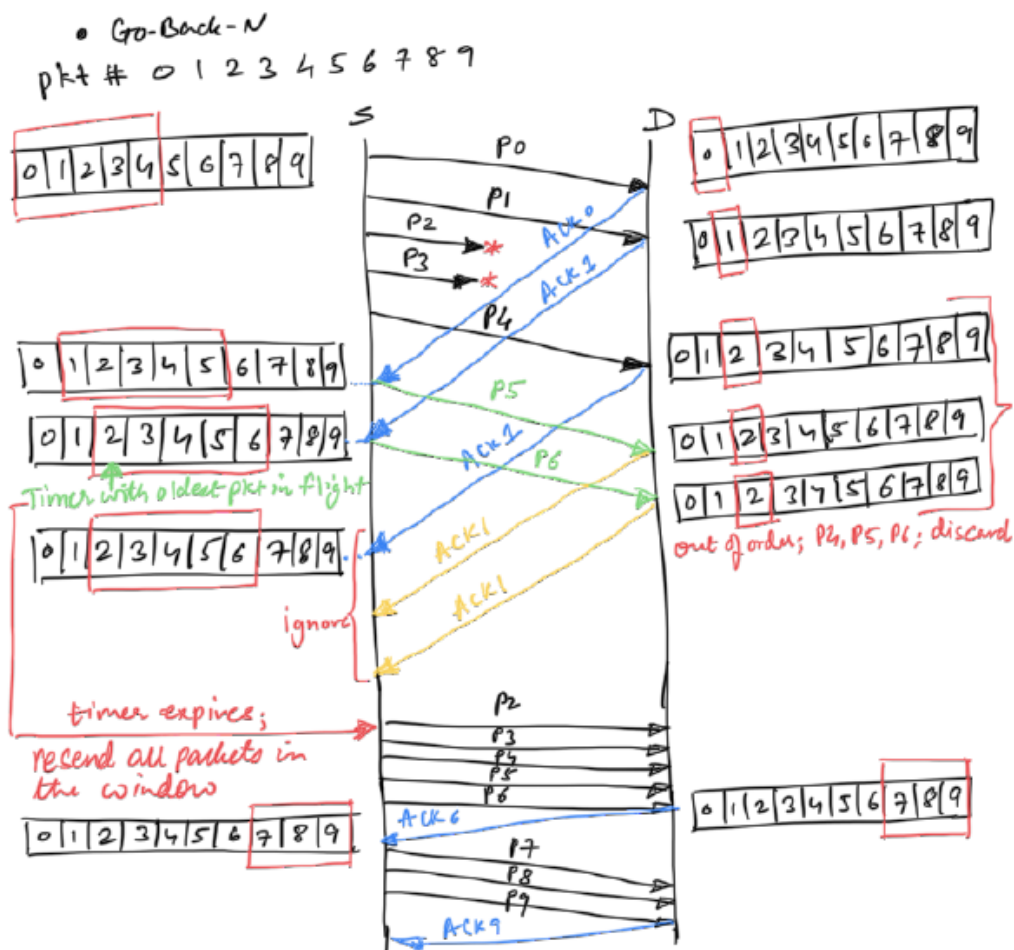
Q.6. Consider the following timing diagram. Suppose that the **window size N=5** and four bits are used to represent sequence numbers (**k=4**). The sender has only **10 packets** to send. Also, suppose apart from packets 2 and 3 being lost for the first time they are sent, there are no other losses. Complete the timing diagram highlighting the acknowledgment numbers, packet sequence number, and packet sequences in the window. Do this for both:

- (a) **Go-back-N** (receiver window size=1)
- (b) **Selective Repeat**.

Please do not explain in the text. Only complete the timing diagram. **[6 marks + 6 marks]**



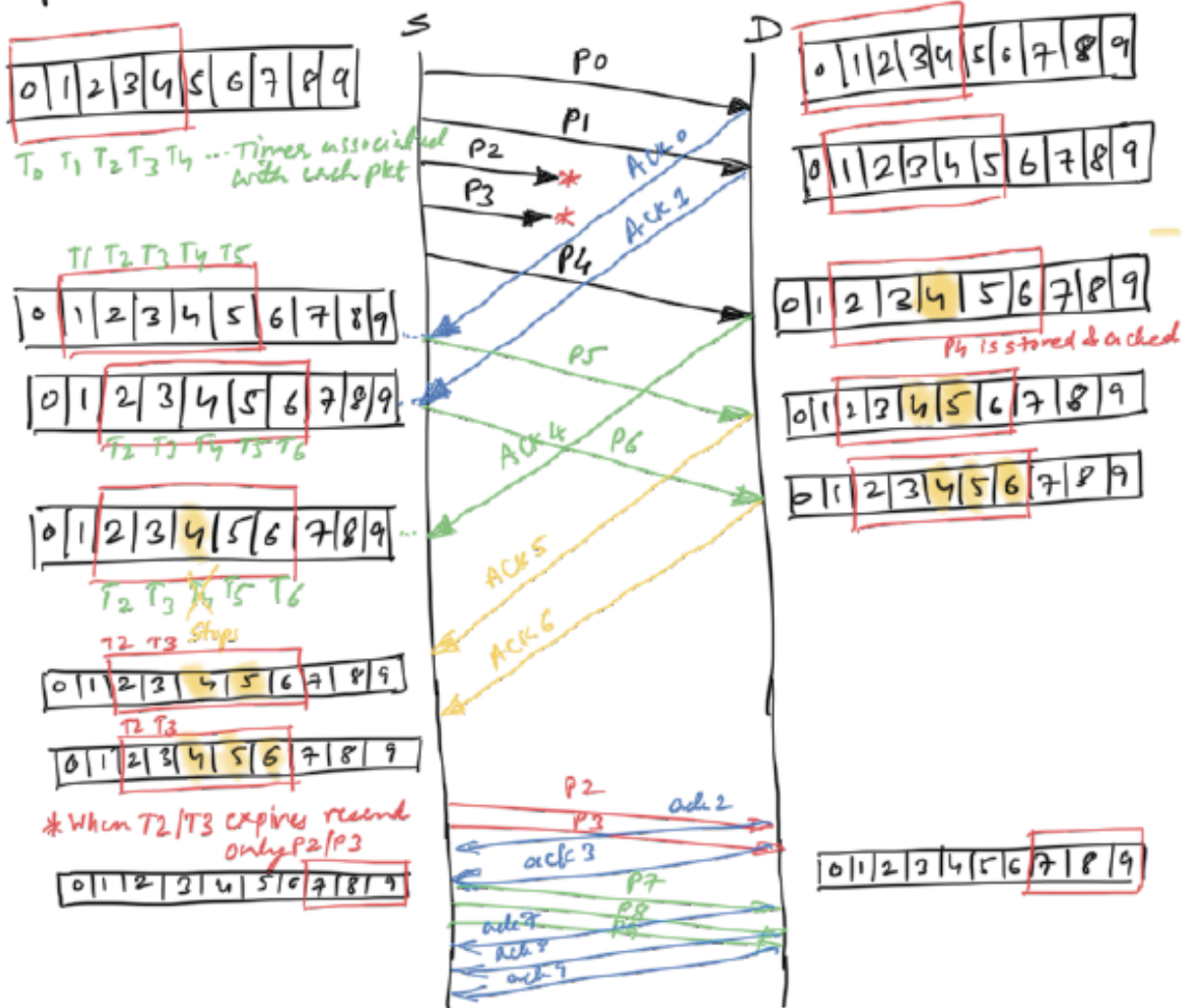
Solution:



Rubric: Timeout: 0.5, packets in response to timeout: 0.5, all acks correct 2, all packet sequences correct 1, all sliding windows correct 2 (sender side correct 1, receiver side correct 1)

• Selective Repeat $N=5$

pkt # 0 1 2 3 4 5 6 7 8 9



Rubric: Timeout: 0.5, packets in response to timeout: 0.5, all acks correct 2, all packet sequences correct 1, all sliding windows correct 2 (sender side correct 1, receiver side correct 1)

Note:

1. There could be certain changes in the timing diagram due to assumptions about when the timer expires. Such cases will be individually considered.
2. The packet sequence numbers, ACK sequence numbers, and the window state will be considered for evaluation. Additional explanation in the solution is only for your understanding.

Q.7. Suppose you have a network with two machines. You are asked to share a large number of 100MB files within the network.

- (a) Would you prefer to design your network as a P2P network and use solutions such as bit-torrent for file sharing? Justify your answer in a maximum of TWO sentences.

Mathematical equations are NOT expected for justification. **[1 mark]**

Ans: For 2 machines, a client/server design is suitable. For both, P2P and client/server at least a single copy of the file has to be created.

A P2P design implementation would involve additional overheads such as an additional tracker node, communication with the tracker, and maintaining redundant data.

- (b) Suppose you choose to design the network using a client/server paradigm for file sharing. Given that the underlying link is unreliable,

- (i) Which application layer protocol should be used? **[1 mark]**

Ans: File Transfer Protocol (FTP)

- (ii) Which transport layer protocol should be used? **[1 mark]**

Ans: Transmission Control Protocol (TCP)

_____ **THE END** _____