Indian Institute of Technology Patna
Date: 30 Sep 2023
MIDSEM: CS358 Computer Networks

DURATION: 2 HOURS

Full Marks 130

Instruction: No doubts would be entertained. Write suitable assumptions, if necessary. Students are allowed to use scientific calculators. Calculations are in terms of 10^x. Like 1Gbps = 10^9, 1Mbps = 10^6, 1Kbps = 10^3 and so on. Each question from Q1 should start on a fresh page. So if the Q1 takes 1/2 page to finish, begin Q2 from the next page.

Q(1) a) What is the difference between Flow Control & Congestion Control **[Marks 5]**

b) Consider sending a packet from a sending host to a receiving host over a fixed route. List the delay components in the end-to-end delay computation. Which of these delays are constant and which are variable? Briefly describe the delays in 1-2 lines each. Also show a pictorial representation of the delay using a small network example. **[Marks 5]**

Q(2) Stop-and-Wait ARQ. Think about a scenario where sender A and receiver B engage in stop-and-wait ARQ communication. Let's say A uses the initial sequence number (ISN) 300; in other words, let's say ISN=300. Let's assume that A sends B 100 bytes in the first packet that the two of them exchange. **[Marks 10]**

(a) What is the SN number that A puts into the packet header (such as for example a TCP packet header)?

(b) If B receives the first 100 bytes packet from A without an error, what is the ACK number that B uses in the packet that is sends to A in response to the packet it received?

(c) If B detects an error in the first 100 bytes packet that it receives from A, what is the ACK number that B uses in the packet that is sends to A in response to the packet it received?

(d) Which flag is set by B while sending the previous packet?

Q(3) Consider a TCP connection between two applications running on two end-hosts A and B. **[Marks 20]**

(a) For hosts A and B, show a diagram of the three-way TCP handshake. Assume A initiates the process.

(b) Indicate which flags are set for each packet represented in the diagram in (a), as well as which (important) information is contained in the TCP packet header. Enter the response as text.

(c) Give a brief explanation of the three-way handshake packets' functions.

(d) Justify why a two-way handshake wont suffice for a TCP connection

Q(4) A 10,000 bit message traveling through two routers R1 and R2 from source node A to destination node B. The path's three links all have a 30 ms delay. R1 and R2 transmit data at a rate of 1000 bits per second, while Node A transmits data at 100 bits per second. For simplicity's sake, we assume that this is a store-and-forward system, that there is no queueing delay, and that all header overheads are irrelevant. **[Marks 10]**

(a) Find the end-to-end latency of the message when it is sent as a whole.

(b) Find the message's end-to-end delay after it has been divided into 10 packets, each 1000 bits in size, and then transmitted to the destination..

Q(5) Using a dependable stop-and-wait protocol, an application must send 100KB of data. The protocol divides the data into chunks with a 1KB application data payload. Each segment fits within a single IP packet. There is no packetization or queuing delay, and the RTT is 50 ms. The protocol has no retransmission cap and a set retransmission timeout of 200ms. How long, in seconds, will the transfer take if the network doesn't duplicate, drop, or corrupt any packets? Since there is no additional latency from connection setup and only data transactions are occurring, you can assume the connection is already established when you begin your test. Your response needs to be precise to two decimal places. **[Marks 5]**

Q(6) You type the following URL into your web browser: http://iitp.ac.in/dept/cse.html Assuming that

- your DNS resolver is 8.8.8.8.
- neither your host nor your DNS resolver have any cached DNS entries,
- DNS never needs to fail over to TCP, and
- the HTML response returns 200 OK with a web page,
- the HTML request and response each fit in a single segment, and
- the web page requires loading no additional resources,

Write down the series of packet exchanges that will occur for your host to receive the web page. Include packets sent by your DNS server as well as control packets for TCP connection setup and teardown. You need not include any ARP packets, and you do not need to write down message/packets formats. Simple descriptions such as 'X sends a UDP segment to the HTML server on the HTTP port' are suficient. In the case of the HTTP request, clearly state the path of the file requested in the GET. **[Marks 10]**

Q(7) (a) List three services provided by TCP that are not provided by UDP. **[Marks 3]**

(b) Give two examples of similarities between TCP and UDP. **[Marks 2]**

(c) For each of the following applications, indicate whether you believe TCP or UDP would be more appropriate, and briefly explain why. Any assumptions you are making for each application should be stated. **[Marks 5]**

- Streaming video client/server.
- Multiplayer online first-person shooting game.
- IRC (chat) client/server.
- Internet telephony voice channel.
- A protocol designed to synchronize the clocks of computers over a network.

Q(8) Using the following criteria, compare and contrast Go-Back-N and Selective Repeat. **[Marks 6*2+1*3=15]**

(1) Comment on the interpretation of the Acknowledges being different?
(2) Comment on the interpretation of timeout being different?
(3) How is the number of timers required at the sending node being different?
(4) Comment on the memory requirement at the receiving node being different?
(5) Comment on the actual amount of packets in-flight being different?
(6) Comment on the amount of packet retransmission being different?
(7) Let's say we are aware that the majority of packet losses on the Internet are caused by congestion, and that during periods of congestion, successive packets frequently end up being completely lost as a result of buffer overflow at the intermediate routers. Which is more effective for the Internet, Go-Back-N or Selective Repeat? Then why?

Q(9) Define each phrase and spell out the main distinction(s) between the two for each of the technical term pairings below. Be succinct and clear. If you're unsure about your definition, feel free to add a pertinent example. **[Marks 3*3+1=10]**

(a) 'circuit-switched' and 'packet-switched'.

(b) 'client-server' and 'peer-to-peer'.

(c) 'positive ACK' and 'negative ACK'.

(d) What is the 4 tuple identifier for a TCP connection?

Q(10) The following is a dump of a UDP header in hexadecimal form: 08 12 00 1F 00 1C E2 17. What is the

(A) Source port number

(B) Destination port number

(C) Total length of the UDP

(D) Length of tha data

(E) Considering that an IP frame can have a maximum total length of 65 535 bytes, what is the maximum length of the data in a UDP frame?

Provide your answers in decimal format. **[Marks 2*5=10]**

Q(11) DNS uses two methods for resolving host names to IP address. What are those? Resolve the URL cse.iitp.ac.in using both the methods and show a diagram for both the methods indicating relevant numbers on the edge. **[Marks 10]**

Q(12) State True or False. -1 for wrong answer. +1 for correct. **[Marks 1*10=10]**

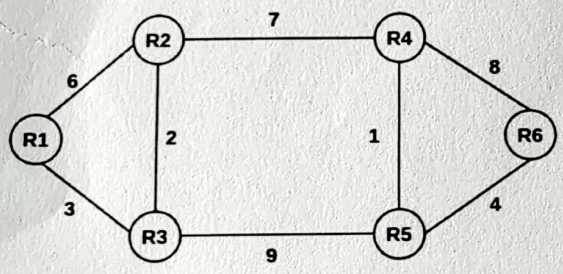
1) A set of rules that governs internet is called protocol.
2) A document that uses HTTP is called a web page.
3) A computer is identified by 64 bit IP address.
4) Every object on the Internet has a unique URL.
5) TCP is a connection oriented protocol.
6) UDP is a connection oriented protocol.
7) UDP is a connectionless protocol.
8) PING checks if a computer is connected to a network or not.
9) IMAP, SMTP, POP3 are all email protocols.
10) HTTP is a secure protocol.

Indian Institute of Technology Patna
Date: Sunday, 3 Dec 2023
Endsem: CS358: Computer Networks
Duration: 3 hours Full Marks: 100.
Part A max marks 70.
Part B max marks 30.

Instruction for Part A: No doubts would be entertained. Write suitable assumptions, if necessary. Students are allowed to use scientific calculators. Calculations are in terms of 10^x. Like 1Gbps $= 10^9$, 1Mbps $= 10^6$, 1Kbps $= 10^3$ and so on unless explicitly mentioned. Each question from Q1 should start on a fresh page. So if the Q1 takes 1/2 page to finish, begin Q2 from the next page.

Part A begins from Q1 and ends at Q12. Answer all Questions in a "Separate Sheet (32 pages one)" and write 'PART-A' on the top of the sheet. Please be brief and concrete in your answers. Max Marks: 70 for Part A

—– Part A Begins —–



Q(1) Consider a network with 6 routers R1 to R6 connected with links having weights as shown in the above diagram. All the routers use the distance vector based routing algorithm to update their routing tables. Each router starts with its routing table initialized to contain an entry for each neighbour with the weight of the respective connecting link. After all the routing tables stabilize, how many links in the network will never be used for carrying any data. Mention those links which would never be used?. You need to only write the direct answer, no need to make routing tables. **[Marks 10]**

Q(2) Consider a firm is allocated a Class C network 192.168.12.0. The firm building consists of four floors with 69, 34, 21 and 12 as the number of machines present on each floor. Discuss how the address space should be divided into different blocks such that each block caters to a floor. Mention all the necessary details like network id, range of addresses (for each subnet) and maximum number of hosts possible in each subnet. **[Marks 10]**

Q(3) Differentiate between datagram subnet & virtual circuit (on any 5 points given below) **[Marks 5]**
Circuit setup, Addressing, State information, Routing, Effect of router failures, Quality of service, Congestion control.

Q(4) The sample RTT is 100ms. Compute the estimated RTT using $\alpha = 0.125$, and assume that the value of the estimated RTT just before the sample RTT was 110ms. **[Marks 5]**

Q(5) If the two data unit to be transmitted are 10101001 & 00111001, what is the checksum computed at the sender side? Show using the same example on how despite some erroneous transmission in the original bits, it may still be interpreted correctly at the receiver end. **[Marks 5]**

Q(6) Below is a wrong mapping of HTTP Codes. Map the correct code responses. Full credit only when all are correct. No partial or negative marking. **[Marks 5]**

Table 1: Wrong Mapping

200	HTTP Version Not Supported
301	Not Found
400	OK
404	Bad Request
505	Moved Permanently

Q(7) Station A needs to send a message consisting of 9 packets to Station B using a sliding window (window size 3) and Go-back-N error control strategy. All packets are ready and immediately available for transmission. If every 5th packet that A transmits gets lost (but no acks from B ever get lost), then what is the number of packets that A will transmit for sending the message to B? Justify. **[Marks 5]**

Q(8) Classless Inter-domain Routing (CIDR) receives a packet with address 131.23.151.76. The router's routing table has the following entries: **[Marks 5]**

• Prefix	Output Interface Identifier
• 131.16.0.0/12	3
• 131.28.0.0/14	5
• 131.19.0.0/16	2
• 131.22.0.0/15	1

The identifier of the output interface on which this packet will be forwarded is _____. Justify your answer.

Q(9) Assume that source S and destination D are connected through two intermediate routers labeled R as shown:
$S--R--R--D$
Determine how many times each packet has to visit the network layer and the data link layer during a transmission from S to D. **[Marks 5]**

Q(10) Consider a source computer (S) transmitting a file of size 10^6 bits to a destination computer (D) over a network of two routers (R1 and R2) and three links (L1, L2, and L3). L1 connects S to R1; L2 connects R1 to R2; and L3 connects R2 to D. Let each link be of length 100km. Assume signals travel over each link at a speed of 10^8 meters per second. Assume that the link bandwidth on each link is 1Mbps. Let the file be broken down into 1000 packets each of size 1000 bits. Find the total sum of transmission and propagation delays in transmitting the file from S to D. **[Marks 5]**

Q(11) The following is a dump of a UDP header in hexadecimal form: 04 21 00 0B 00 2A E2 17. Asnwer the following: **[Marks 5]**

(A) Source port number

(B) Destination port number

(C) Total length of the UDP

(D) Length of the data in UDP Segment

(E) Is UDP protocol stateless of state-full?

Q(12) Answer true or false to the following questions and justify your answer: **[Marks 5]**

(A) With the SR protocol, it is possible for the sender to receive an ACK for a packet that falls outside of its current window.

(B) With GBN, it is possible for the sender to receive an ACK for a packet that falls outside of its current window.

(C) The alternating-bit protocol is the same as the SR protocol with a sender and receiver window size of 1.

(D) The alternating-bit protocol is the same as the GBN protocol with a sender and receiver window size of 1.

(E) DNS uses TCP.

— Part A Ends —

— Part B Begins —

Part B begins from Q13. Answer all Questions in a "Separate Sheet (32 pages one)" and write 'PART-B' on the top of the sheet. Please be brief and concrete in your answers. There is a choice with question nos. 16, 17, and 18, attempt any two out of these three questions. Max Marks: 30 for Part B

Q(13) (a) A complex bandpass signal has a bandwidth of 200 kHz. Can we find the minimum sampling rate for this signal? If yes, what would it be?
(b) In a digital transmission, the receiver clock is 0.1 percent faster than the sender clock. How many extra bits per second does the receiver receive if the data rate is 1 Mbps?
(c) Calculate the propagation time and the transmission time for a 5-Mbyte message (an image) if the bandwidth of the network is 1 Mbps? Assume that the distance between the sender and the receiver is 12,000 km and that light travels at $2.4*10^8 m/s$. **[Marks 1.5+1.5+3=6]**

Q(14) Which of the four digital-to-analog conversion techniques (ASK, FSK, PSK or QAM) is the most susceptible to noise? Defend your answer **[Marks 3]**

Q(15) Write the characteristics of a good polynomial generator needs to have. Which of the following generators g(x) values guarantees that a single-bit error is caught? For each case, what is the error that cannot be caught? Can any of these generators also be able to detect two isolated, single-bit errors? **[Marks 3+2 +2+2=9]**

(a) $x+1$

(b) x^3+1

(c) $x^{15}+x^{14}+1$

(d) x^3

Q(16) Write the procedure for CSMA/CD protocol. A network using CSMA/CD has a bandwidth of 20 Mbps. If the maximum propagation time (including the delays in the devices and ignoring the time needed to send a jamming signal) is 25.6μsec, what is the minimum size of the frame? **[Marks 4+2=6]**

Q(17) Explain the reason for moving from the Stop-and-Wait ARQ Protocol to the Go Back- N ARQ Protocol. If the sequence number field is n bits long in the control field, what should be the maximum size of the sliding window in Go Back N ARQ protocol? Justify your Answer. **[Marks 3+3=6]**

Q(18) We have four sources, each creating 250 characters per second. If the interleaved unit is a character and 1 synchronizing bit is added to each frame, find (a) the data rate of each source, (b) the duration of each character in each source, (c) the frame rate, (d) the duration of each frame, (e) the number of bits in each frame, and (f) the data rate of the link. **[Marks 6]**

— Part B Ends —
