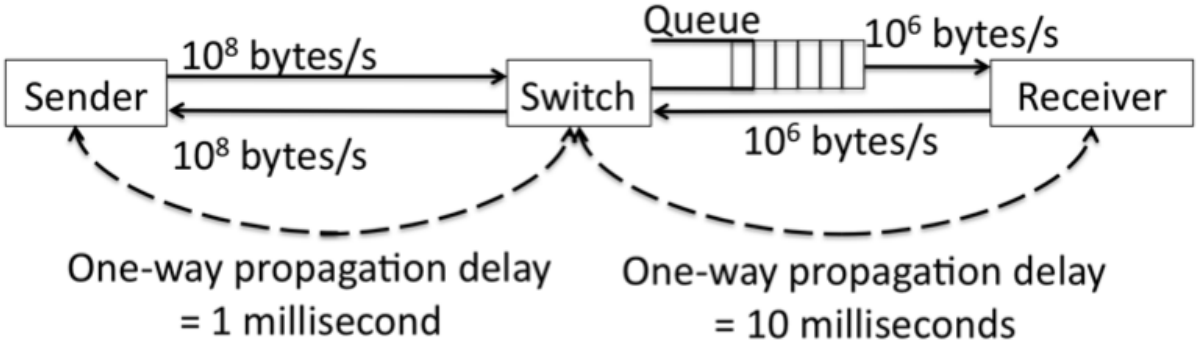
Activity 2: Marks: 20: School of Computer Engineering, KIIT DU

Computer Network (Sections 2 / 28)

1. In a packet switching network, packets are routed from source to destination along a single path having two intermediate nodes. If the message size is 24 bytes and each packet contains a header of 3 bytes, then the optimum packet size is:
    - 4
    - 6
    - 7
    - 9
2. Consider-
    - There is a network having bandwidth of 1 Mbps.
    - A message of size 1000 bytes has to be sent.
    - Packet switching technique is used.
    - Each packet contains a header of 100 bytes.

    Out of the following, in how many packets the message must be divided so that total time taken is minimum- 1 packet, 5 packets, 10 packets, 20 packets.

3. You send a stream of packets of size 1000 bits each across a network path from Cambridge to Berkeley. You find that the one-way delay varies between 50 ms (in the absence of any queueing) and 125 ms (full queue), with an average of 75 ms. The transmission rate at the sender is 1 Mbit/s; the receiver gets packets at the same rate without any packet loss.
    a. What is the mean number of packets in the queue at the bottleneck link along the path (assume that any queueing happens at just one switch).
    b. What is the packet loss rate at the switch?
    c. What is the average one-way delay now?
4. Consider the network topology shown below. Assume that the processing delay at all the nodes is negligible.



    - The sender sends two 1000-byte data packets back-to-back with a negligible inter-packet delay. The queue has no other packets. What is the time delay between the arrival of the first bit of the second packet and the first bit of the first packet at the receiver?
    - The receiver acknowledges each 1000-byte data packet to the sender, and each acknowledgment has a size A = 100 bytes. What is the minimum possible round-

trip time between the sender and receiver? The round trip time is defined as the duration between the transmission of a packet and the receipt of an acknowledgment for it.

5. Ritu has developed a new switch. In this switch, 10% of the packets are processed on the "slow path", which incurs an average delay of 1 millisecond. All the other packets are processed on the "fast path", incurring an average delay of 0.1 milliseconds. Annette observes the switch over a period of time and finds that the average number of packets in it is 19. What is the average rate, in packets per second, at which the switch processes packets?
6. Calculate the latency (total delay from first bit sent to last bit received) for the following:
   - Sender and receiver are separated by two 1-Gigabit/s links and a single switch. The packet size is 5000 bits, and each link introduces a propagation delay of 10 microseconds. Assume that the switch begins forwarding immediately after it has received the last bit of the packet and the queues are empty.
   - Same as (A) with three switches and four links.
7. Host A is sending data to host B over a full duplex link. A and B are using the sliding window protocol for flow control. The send and receive window sizes are 5 packets each. Data packets (sent only from A to B) are all 1000 bytes long and the transmission time for such a packet is 50 microsecond Acknowledgement packets (sent only from B to A) are very small and require negligible transmission time. The propagation delay over the link is 200 microseconds. What is the maximum achievable throughput in this communication?
8. If a logical address is 32 bits (4 bytes), what is the minimum header size at network layer of the TCP/IP protocol suite?
9. In a TCP connection, consider that Host A is sending data to Host B, and Host B is simultaneously sending data to Host A. Host B receives a segment from Host A and wants to acknowledge it. Instead of sending a separate acknowledgment (ACK), Host B decides to send its own data segment to Host A along with the acknowledgment. What is this process called in TCP?
10. What is the maximum possible value of the TCP header length in bytes that can be represented using this 4-bit field?
11. If a physical address is 48 bits (6 bytes) what is the minimum header size at the data link layer of the TCP/IP protocol suite?
12. On a TCP connection the window size advertise by the receiver is 12KB, the last byte sent by sender is 23400(Seq no) and the last byte acknowledge by receiver is 9123(seq no). Find the current window / effective window size at the sender.
13. In selective Repeat Sliding window protocol, suppose frame through 0 to 6 have been transmitted, now imagine that 1 time out, 7 (New frame) is transmitted, 2 times out, 3 times out and 8 (another new frame) is transmitted. At this point what will be the outstanding packet in senders window. Explain your answer with proper sliding window diagram.
14. Why do you think there is a need for four levels of addresses in the Internet, but only one level of addresses (telephone numbers) in a telephone network?
15. An ICMP message has arrived with the header (in hexadecimal): **03 0310 20 00 00 00 00,** What is the type of the message? What is the code? What is the purpose of the message?
16. A computer sends a timestamp request to another computer. It receives the corresponding timestamp reply at 3:46:07 A.M. The values of the original timestamp, receive timestamp, and transmit timestamp are 13,560,000, 13,562,000, and 13,564,300, respectively. What is the sending trip time? What is the receiving trip time? What is the round-trip time? What is the difference between the sender clock and the receiver clock?

17. If two computers are 5000 miles apart, what is the minimum time for a message to go from one to the other?
18. Using 5-bit sequence numbers, what is the maximum size of the send and receive windows for each of the following protocols?
    a. a. Stop-and-Wait
    b. b. Go-Back-N
    c. c. Selective-Repeat
19. A sender sends a series of packets to the same destination using 5-bit sequence of numbers. If the sequence number starts with 0, what is the sequence number of the 100th packet?
20. Assume that, in a Stop-and-Wait system, the bandwidth of the line is 1 Mbps, and 1 bit takes 20 milliseconds to make a round trip. What is the bandwidth-delay product? If the system data packets are 1,000 bits in length, what is the utilization percentage of the link?
21. Assume that, in a Stop-and-Wait system, the bandwidth of the line is 1 Mbps, and 1 bit takes 20 milliseconds to make a round trip. What is the bandwidth-delay product? if we have a protocol that can send up to 15 packets before stopping and worrying about the acknowledgments?
22. Assume a sender sends 6 packets: packets 0, 1, 2, 3, 4, and 5. The sender receives an ACK with ackNo = 3. What is the interpretation if the system is using GBN or SR?
23. The following is a dump of a UDP header in hexadecimal format: **CB84000D001C001C**
    a. What is the source port number?
    b. What is the destination port number?
    c. What is the total length of the user datagram?
    d. What is the length of the data?
    e. Is the packet directed from a client to a server or vice versa?
    f. What is the client process?
24. What value is sent for the checksum in one of the following hypothetical situations?
    - The sender decides not to include the checksum.
    - The sender decides to include the checksum, but the value of the sum is all 1s.
    - The sender decides to include the checksum, but the value of the sum is all 0s.
25. A client uses UDP to send data to a server. The data length is 16 bytes. Calculate the efficiency of this transmission at the UDP level (ratio of useful bytes to total bytes).
26. The following is a dump of a UDP header in hexadecimal format: **0045DF000058FE20**
    g. What is the source port number?
    h. What is the destination port number?
    i. What is the total length of the user datagram?
    j. What is the length of the data?
    k. Is the packet directed from a client to a server or vice versa?
    l. What is the client process?
27. Answer the following questions:
    a. What is the minimum size of a UDP datagram?
    b. What is the maximum size of a UDP datagram?
    c. What is the minimum size of the process data that can be encapsulated in a UDP datagram?
    d. What is the maximum size of the process data that can be encapsulated in a UDP datagram?
28. What can you say about the TCP segment in which the value of the control field is one of the following:
    a. 000000
    b. 000001
    c. 010001

d. 000100
e. 000010
f. 010010

29. The following is a dump of a TCP header in hexadecimal format.

$(05320017\ 00000001\ 00000000\ 500207FF\ 00000000)_{16}$

a. What is the source port number?
b. What is the destination port number?
c. What the sequence number?
d. What is the acknowledgment number?
e. What is the length of the header?
f. What is the type of the segment?
g. What is the window size?

30. If the value of HLEN is 0111, how many bytes of option are included in the segment?
31. What is the maximum size of the TCP header? What is the minimum size of the TCP header?
32. Compare the TCP header and the UDP header. List the fields in the TCP header that are not part of the UDP header. Give the reason for each missing field.
33. In a TCP connection, the initial sequence number at the client site is 2,171. The client opens the connection, sends only one segment carrying 1,000 bytes of data, and closes the connection. What is the value of the sequence number in each of the following segments sent by the client?
    a. The SYN segment?
    b. The data segment?
    c. The FIN segment?
34. In a connection, the value of cwnd is 3000 and the value of rwnd is 5000. The host has sent 2,000 bytes, which have not been acknowledged. How many more bytes can be sent?
35. TCP is sending data at 1 megabyte per second. If the sequence number starts with 7,000, how long does it take before the sequence number goes back to zero?
36. A TCP connection is using a window size of 10,000 bytes and the previous acknowledgment number was 22,001. It receives a segment with acknowledgment number 24,001 and window size advertisement of 12,000. Draw a diagram to show the situation of the window before and after.
37. A window holds bytes 2001 to 5000. The next byte to be sent is 3001. Draw a figure
38. to show the situation of the window after the following two events.
    a. An ACK segment with the acknowledgment number 2500 and window size advertisement 4000 is received.
    b. A segment carrying 1,000 bytes is sent.
39. A TCP connection is in the ESTABLISHED state. The following events occur one after another:
    a. A FIN segment is received.
    b. The application sends a “close” message.

    What is the state of the connection after each event? What is the action after each event?
40. Draw TCP header and explain in details about all the segments with size.
41. Show the message transfer phase from aaa@xxx.com to bbb@yyy.com. The message is “Good morning my friend.”.
42. Draw and explain OSI Model with details explanation of each layer. Also compare the OSI against TCP/IP.

***Date of Submission: September 28, 2024 {For every one day late there is -1}**

***All should submit a hardcopy of your answers at my cabin [Campus 14, 104]**