AUTUMN MID SEMESTER EXAMINATION-2023

School of Computer Engineering
Kalinga Institute of Industrial Technology, Deemed to be University
Computer Network
[IT-3009]

Time: 1 1/2 Hours **Full Mark: 40**

Answer Any four Questions including Question No. 1 which is compulsory.
The figures in the margin indicate full marks. Candidates are required to give their answers in their own words as far as practicable and all parts of a question should be answered at one place only.

1. Answer all the questions. [2 x 5]

a) The following is the contents of a UDP header in hexadecimal format. **CB840050001F001F**
I)What is the length of the data?
II)What is the destination port number?
ANS: 31-8=23 and 80

b) Consider 2 computers x and y connected by a single line of bandwidth 512 mbps. Let propagation speed be $2x10^9$ meter per second. The the packet length be 1 kb. Calculate the distance between x and y if propagation delay is same as transmission delay.
ANS: Given in, Transmission delay = Propagation delay
According to formula
L/B=m/V
m=(L/B)*V=(1024/512*10^6)*2*10^9 = 4 km

c) Why TCP uses a 32 bit sequence number in TCP header? In TCP how many sequence numbers are consumed by each of the following segments: **ACK, SYN +ACK, FIN**.
ANS: Unique sequence number. TCP sequence numbers have a fixed amount of sequence numbers starting from 0 to $(2^{32}-1)$=4GB, which means that we cannot send more than 4 GB of data along with a unique sequence number.
A SYN + ACK segment cannot carry data, but does consume one sequence number. An ACK segment, if carrying no data, consumes no sequence number. The FIN segment consumes one sequence number if it does not carry data.

d) Given a TCP header with a header length field value of 0111, calculate the actual length of the TCP header in bytes. How many bits optional data is added with the header in this case?
ANS: 0111 X 4 = 7 X 4= 28
28-20=8 bytes=64 bits

e) In a network using the Go-Back-N protocol with m = 3 and the sending window of size 7, the values of variables are $\mathbf{S_f}$ = 62, $\mathbf{S_n}$ = 66, and $\mathbf{R_n}$ = 64. Assume that the network does not duplicate or reorder the packets. What are the sequence numbers of data packets in transit?

ANS: Given Rn =64, this indicates the receiver is expecting a packet with sequence number 64.

Given that Sf =62 and Sn=66, this indicates the packet from 62 to 65 are transmitting and are waiting for acknowledgment as Rn =64, the packets with sequence number 62 and 63 are already received by receiver.

The packet number 64 and 65 are in transit from Sender to receiver.

2. [5+5 Marks]

A) A user is suppose to access a Web page. The IP address for the associated URL is not known to the local host, so a DNS lookup is carried out to obtain the IP address. Suppose, n DNS servers are visited before your host receives the IP address from DNS; the successive visits incur an RTT of RTT1, . . ., RTTn. Further suppose that the Web page associated with the link contains exactly one object, consisting of a small amount of HTML text. Let RTT0 denote the RTT between the local host and the server containing the object. Calculate the time elapses from when the client clicks on the link until the client receives the object?

ANS: The total amount of time to get the IP address is RTT1 + RTT2 + ... + RTTn .

Once the IP address is known, RTT0 elapses to set up the TCP connection

Another RTT0 elapses to request and receive the small object.

Hence, The total response time is 2 RTT0 + RTT1 + RTT2 + ... + RTTn

B) Explain Email protocols in detail (SMTP,MIME and POP3).

ANS: Explanation of SMTP, MIME and POP3

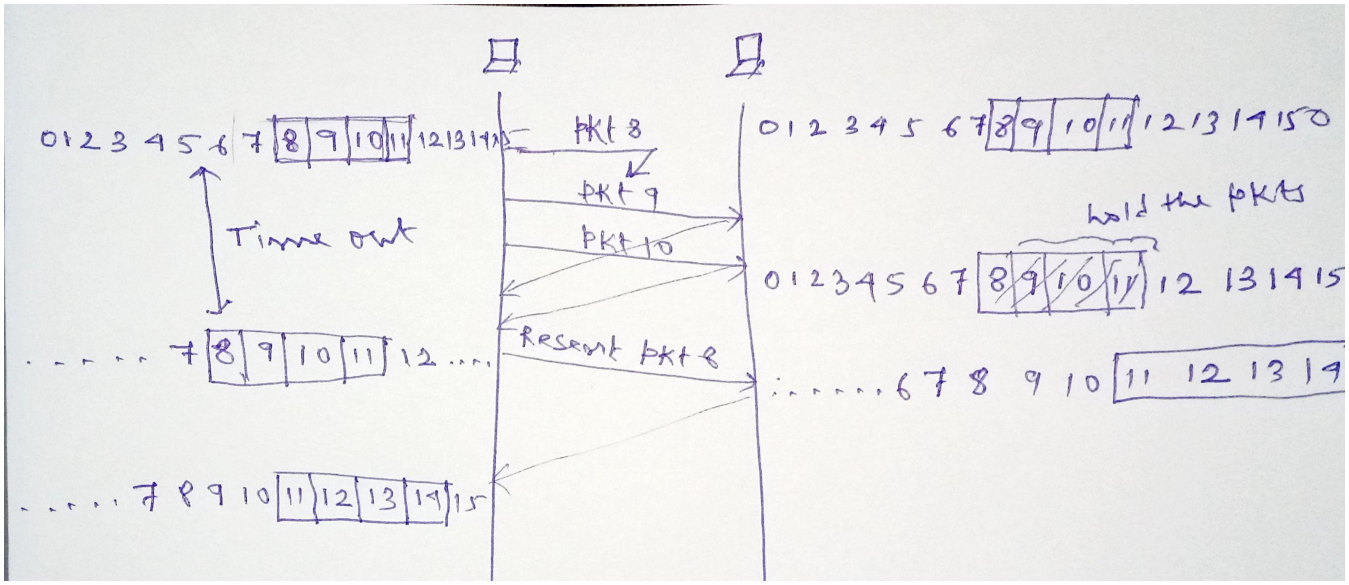
3. [5+5 Marks]

A) Consider a network using the Selective Repeat protocol for reliable data transmission. The sender's window size is 4 and the receiver's window size is also 4. The sequence numbers are 0 to 15. The sender has sent packets up to sequence number 10, and all acknowledgments up to sequence number 7 have been received by the sender.

I) Illustrate the sender's and receiver's window positions on a sequence number line. [2.5 Marks]

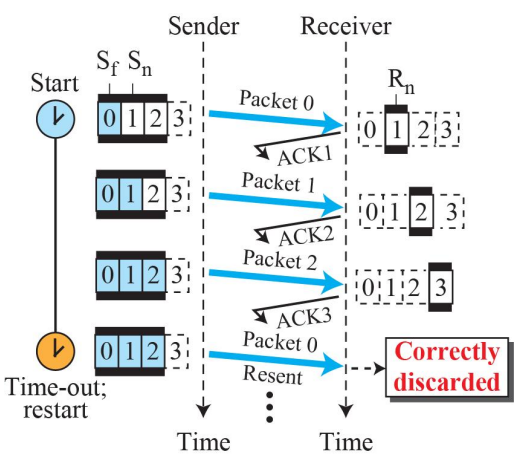
II) If the receiver has received packets up to sequence number 9 correctly but packet with sequence number 8 was lost, explain how the receiver and sender will respond. [2.5 Marks]

ANS:

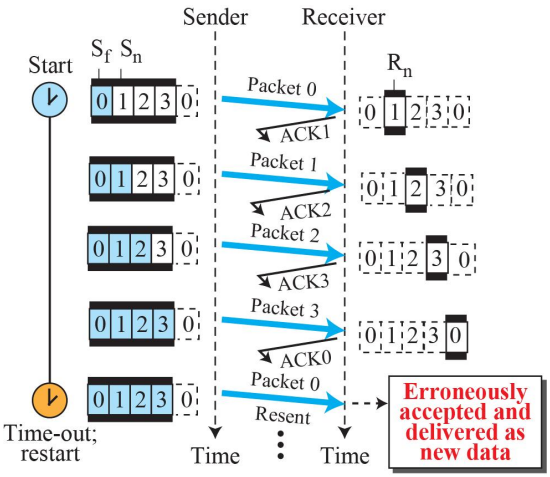


B) Why does the Selective repeat protocol use the maximum window size 2^{m-1} and Go-Back-N protocol use 2^m-1? Justify your answer with appropriate examples.

ANS: Go-Back-N [2.5 Marks]

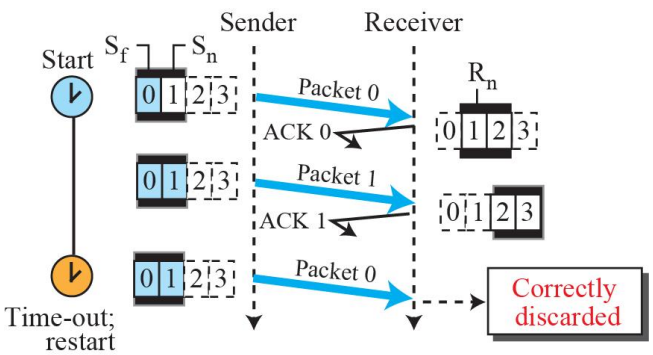


a. Send window of size < 2^m

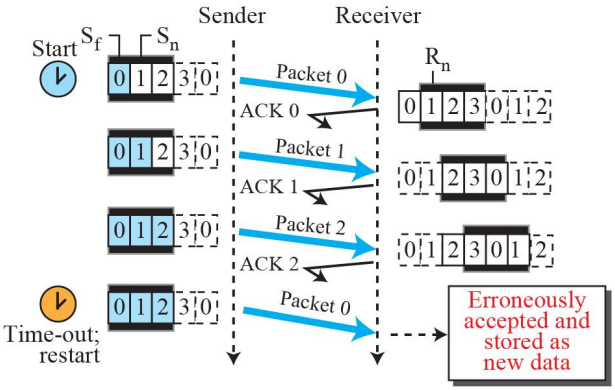


b. Send window of size = 2^m

Selective repeat [2.5 Marks]



a. Send and receive windows of size = 2^{m-1}



b. Send and receive windows of size > 2^{m-1}

4. [5+5 Marks]

A) Consider a scenario where Host A is establishing a TCP connection with Host B. Host A initiates the connection by sending a TCP segment with the SYN flag set to 1 and the Sequence Number set to 1000. Host B responds with a TCP segment with both the SYN and ACK flags set to 1, Acknowledgment Number set to 1200, and Sequence Number set to 2000.

I) Explain the significance of the SYN and ACK flags in the initial connection setup.

ANS: Explanation of connection establishment using SYN and ACK (Time diagram or FSM) [2 Marks]

II) What is the next expected Sequence Number that Host A should use when sending data to Host B?

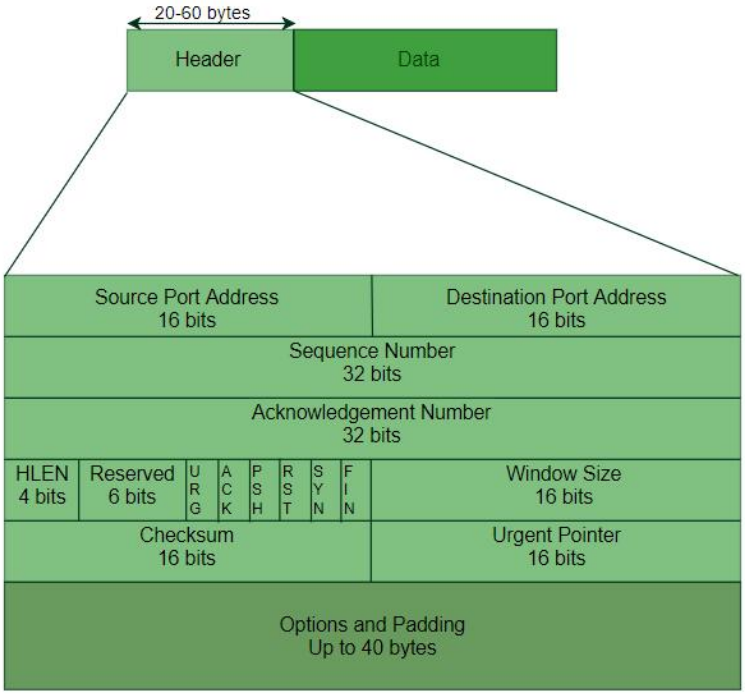
ANS: We can consider both the answer as 1001 or 1200 [1 Marks]

III) If Host A wants to terminate the connection after exchanging data, in what way would the FIN flag be used?

ANS: Connection termination using FIN. (Time diagram or FSM) [2 Marks]

B) Imagine you are designing a network application that will use TCP for reliable data transmission. Provide a comprehensive explanation of the various components and fields present in a TCP segment. Your explanation should cover the purpose and significance of each components of TCP segment.

ANS: Explanation of the purpose and significance of each components of TCP segment.



5. [5+5 Marks]

A) Suppose host A is sending a large file to host B over a TCP connection. The two end hosts are 10 ms apart (20 ms RTT) connected by a 1 Gbps link. Assume that they are using a packet size of 1000 bytes to transmit the file. For simplicity ignore ack packets. Atleast how big would the window size (in packets) have to be for the channel utilization to be greater than 80% ?

ANS:

Given-
Round Trip Time = 20 ms
Bandwidth = 1 Gbps
Packet size = 1000 bytes
Efficiency >= 80%

For 100% efficiency,
Window size
= Maximum number of bits that can be transmitted in 1 RTT
= 1 Gbps x 20 msec
= 10^9 bits per sec x 20 x 10^{-3} sec
= 20 x 10^6 bits
= 2 x 10^7 bits

For 80% efficiency,
Window size
= 0.8 x 2 x 10^7 bits
= 1.6 x 10^7 bits

In terms of packets,
Window size
= 1.6 x 10^7 bits / Packet size
= 1.6 x 10^7 bits / (1000 x 8 bits)
= 0.2 x 10^4 packets
= 2000 packets

B) What is the difference between centralized P2P network and decentralized P2P network? In a DHT-based network, assume m = 4. If the hash of a node identifier is 18, where is the location of the node in the DHT space?

ANS: Difference between centralized P2P network and decentralized P2P network. [4 Marks]

There are only 2m =16 points on the circle (0 to 15). We need to use modular arithmetic to find the location of the node. Since 18 mod 16=2, the node is located at the point marked 2 on the address space circle. [1 Marks]

*** Best of Luck ***