CLO 2 (Q#2,3&4): **Demonstrate** the basics of network concepts using state-of-the-art network tools/techniques.

Q2: A public Server S (IP Address: 203.0.113.1/24) hosts two services: a DNS server running on UDP port 53 and a Web server running on TCP port 80. Two clients, Client A (IP Address: 192.0.2.10/24) and Client B (IP Address: 192.0.2.20/24), initiate communication with Server S:

1. Client A sends a DNS Query (UDP segment U1). It uses source port of 60001.
2. Client A opens a TCP connection and sends an HTTP GET request (TCP segment T2). It uses source port of 60002.
3. Client B opens a TCP connection and sends an HTTP GET request (TCP segment T3). It uses source port 60001, coincidentally matching the port used by Client A's DNS query.

Considering the above scenarios, you are required to answer the following: **[2+4+1 = 7 Marks]**

A. Provide the exact, unique tuple required to identify the socket to which UDP segment **U1** is delivered on Server S. (Format: [Dest IP, Dest Port])
B. Provide the exact, unique tuple required to identify the socket to which TCP segment **T3** is delivered on Server S. (Format: [Source IP, Source Port, Dest IP, Dest Port])
C. If Server S now sends a return DNS response segment (U1 Response) back to Client A, what is the value of the Destination Port Number field in that return segment?

Q3: Consider a reliable data transmission scenario between two hosts A(sender) and B(receiver). Host A has 10 packets to transmit and employs a GO-Back-N protocol with window size N=3 and 16 sequence numbers ranging from 0 to 15. If acknowledgements sent by host B were never lost, and only 5th packet (having sequence number 4) was lost, how many packets in total were transmitted by host A? Support your answer through a timing diagram. **[5 Marks]**

Q4: *Host A* sends a single IPv4 datagram to *Host B* over the Internet. There is a single network path from A to B with two intermediate routers (*R1* and *R2*). Original datagram exiting *Host A* has following values in its IPv4 header: **[7 Marks]**

Total Length (Bytes)	IP Header Length (Bytes)	Identification (ID) (Hexadecimal)	DF Flag	MF Flag	Fragment Offset
1600	20	0xCAFE	0	0	0

Note that while a real IPv4 header field of *IP Header Length* counts words of 4 Bytes, we have used the units of Bytes for simplicity. Additionally note that no IP options are used. Recall that *fragment offset* field is 13 bits wide in IPv4 header. Moreover, DF stands for Don't fragment while MF stands for More Fragments.

Maximum Transmission Unit (MTU) on the link connecting Host A to Router R1 is 9000 Bytes.
MTU on the link connecting router R1 to router R2 is 1500 Bytes.
MTU on the link connecting router R2 to the destination Host B = 512 Bytes.

(a) On your answer sheet, draw a 6-column table (like the example above) and fill in the details for every fragment created by router R1.
(b) On your answer sheet, draw the same 6-column table. Use it to list all sub-fragments (if any) created by router R2 as it processes the packet(s) from R1.

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CLO 3 (Q#5): **Demonstrate** various classical routing and switching protocols via simulations.

Q5: Answer to this question is required to be provided **on the question paper** by completing the given table.

You are given the network 192.168.48.0/22 for an organization with the following subnet requirements:

- CS Department requires 100 hosts.
- IT Department requires 62 hosts.
- Finance Department requires 50 hosts.
- Admin office requires 20 hosts.
- Director office requires 10 hosts.

Your task is to allocate addresses optimally (as per given requirements) performing VLSM as per the given requirements, determine the following for each subnet and complete the table given below (**your final answer should be in dotted decimal notation only**): **[2 x 5 + 1 = 11 Marks]** /10

(i) Prefix / Subnet Mask (ii) Network Address
(iii) First Usable Host Address (iv) Broadcast Address
Moreover, find the leftover / free addresses inside /22 after fulfilling the above requirement optimally.

Department /Office	Subnet Mask	Network Address	First Usable Host Address	Broadcast Address
CS	255.255.255.128	192.168.48.0/25	192.168.48.1/25	192.168.48.127/25
IT	255.255.255.192	192.168.48.128/26	192.168.48.129/26	192.168.48.191/26
Finance	255.255.255.192	192.168.48.192/26	192.168.48.193/26	192.168.48.255/26
Admin	255.255.255.224	192.168.49.0/27	192.168.49.1/27	192.168.49.31/27
Director	255.255.255.240	192.168.49.32/28	192.168.49.33/28	192.168.49.47/28
No. of Free addresses	256.			