Assignment - 2

Question 1: Suppose P, Q, and R are the three routers belonging to regional ISPs. They have been allocated the following IP address blocks by a top-level ISP:

- P: 210.50.10.0/8
- Q: 160.60.0.0/8
- R: 230.70.30.0/8

These routers are connected to the internet via a top-level ISP router G, with the following IP addresses and gateways:

- P: IP - 202.141.55.5, Gateway - 202.141.55.6
- Q: IP - 202.141.56.5, Gateway - 202.141.56.6
- R: IP - 202.141.57.5, Gateway - 202.141.57.6

Router P allocates address space to two customers:

- PA requires 94 nodes.
- PB requires 14 nodes.

Router Q allocates address space to two customers:

- QA requires 800 nodes.
- QB requires 400 nodes.

Tasks:

- Construct the routing tables for routers P, Q, and R.
- Explain how classless addressing can be beneficial in this scenario.

Question2: Assume there are four networks: S1, S2, S3, and S4, connected through three routers. The networks are arranged such that:

- S2 is positioned between S1 and S3.
- S3 is positioned between S2 and S4.

A packet needs to travel from a node N1 in network S1 to a node N4 in network S4.
Task: Show the packet headers, focusing only on the address fields of the Ethernet and Network layers, as the packet flows from node N1 in network S1 to node N4 in network S4.

Question3: MNNIT has been allocated a network with the address 210.212.50.0/22. The institute consists of 8 departments: d1, d2, d3, d4, d5, d6, d7, and d8.
(i) Subnetting for the Departments:
Create subnets for the 8 departments. The host requirements for each department are as follows:

- d1, d2: 150 hosts each
- d3, d4, d5, d6: 20 hosts each
- d7, d8: 10 hosts each

a. Propose a subnetting scheme with:
    - Network ID
    - Broadcast Address
    - Subnet Mask

b. If department d8 wants to increase its number of hosts to 15, what changes should be made?

(ii) Network Topology and Routing:
The institute is connected to the Internet via a 1 Gbps line provided by an ISP. Design a network topology for the institute. The following assumptions should be considered:

a. The router of department d1 is connected to the main router, which in turn connects to the rest of the Internet.
b. Provide the routing table for all routers, including the ISP router.
c. Identify any unassigned address blocks.

(iii) Packet Movement Tracing:

a. Trace the movement of a packet p1 from node n3 in department d3 to node n7 in department d7.
b. Trace the movement of a packet p2 from node n2 in department d2 to a Google server, and the return packet p3 from the Google server back to node n2.

(iv) Scenario with Private and Public IPs:
If MNNIT uses a private IP range 172.31.0.0/16 and a public IP block 202.141.55.0/30 with NAT servers, repeat the following tasks:

a. Subnetting scheme for the departments.
b. Network topology and routing tables.
c. Packet movement traces for p1, p2, and p3 as described in part (iii).

Question4: A host **H** with the IP address **200.40.8.5/24** has the following entries in its ARP cache:

IP Address	MAC Address
200.40.8.10	00:01:02:3A:7F:9C
200.40.8.25	00:02:05:AF:DE
200.40.8.75	00:03:06:DD:CB

Tasks:

a. How can host H send an IP packet to the following destinations:
   - 200.40.8.7
   - 200.40.8.75
   - 200.40.8.100

b. Host R, with the IP address 200.40.8.25, is acting as a router to connect to the 201.50.10.0 network. How will host H send an IP packet to host M, which has the IP address 201.50.10.30?

Additional Information to Provide:

a. Show the source and destination IP addresses and Ethernet (MAC) addresses for each packet.
b. Explain how ARP (Address Resolution Protocol) is used in each case.

Question 5: Answer the following

a. What is the **netmask** for the address **198.1.46.201/22**?
b. How is the netmask of address **198.1.46.201/22** used in **routing**?
c. If the routing table has an entry corresponding to the IP address **198.1.46.201/22**, show this entry in the routing table, assuming the node is **directly connected** to the router.

Question 6: Which of the following group can be used for summarization/aggregation and why. What is the advantage in routing table from route aggregation. What will be starting address and netmask of the subnet after aggregation.
a) 205.52.30.0/24, 205.52.40.0/24, 205.52.50.0/24, 205.52.60.0/24
b) 202.12.16.0/24, 202.12.17.0/24, 202.12.18.0/24, 202.12.19.0/24

Question 7: An organization has 10 departments each with maximum 1000 node requirement. How address 172.16.0.0/16 can be used to create subnet for each department give subnetwork address and broadcast address of each department with subnet mask. If two extra departments get added what address allocation can be made to these departments?

Question8: A router has following entries in its routing table:

address/mask	next hop
135.46.56.0/22	eth0
135.46.60.0/22	eth1
192.53.40.0/23	r1
default	r2

for each of the following IP addresses, what does the router do if the packet with that address arrives?
a) 135.46.63.10 b) 135.46.57.14 c) 135.46.52.2 d) 192.53.40.7 e) 192.53.56.7

Question 9: In the following figure, trace the movement of a **ping packet p1** from **Host A** to the destination **11.11.5.40**.

A ------- R1 ------ R2 ------ R3 ------- Internet

Assume the following:

- **Host A's IP address**: 11.11.5.10/27
- The **initial TTL** of packet p1: 16
- The **default gateway** of Host A is **Router R1**.
  - Router R1's Table:

Destination	Mask	Next Hop
11.11.5.0	/27	-
default	/0	R2

  - Router R2's Table:

Destination	Mask	Next Hop
11.11.5.32	/27	R1
default	/0	R3

Tasks:

a. Trace the movement of ping packet p1 from Host A to 11.11.5.40 through the routers R1, R2, and R3.
b. Show how the TTL value changes at each step.

c. Discuss how the packet is forwarded based on the routing tables provided.

Question 10: An IP datagram carrying 65,536 bytes needs to be transported over an Ethernet LAN. Perform the following tasks:

A. Fragmentation:
   - Show how the IP datagram is fragmented to be transported over Ethernet.
   - Determine how many fragments are required.
   - For the first three fragments and the last two fragments, calculate the offset values in:
     - Binary
     - Hexadecimal
     - Decimal
   - Determine the number of bytes in the last fragment.

B. Passing Through a PPP Link:
   - If the third fragment passes through a PPP link (Point-to-Point Protocol) with a maximum frame size of 296 bytes, what happens to the third fragment?

C. Don't Fragment Bit:
   - If the "Don't Fragment" (DF) bit is set to 1 (true), what happens to the IP datagram when it encounters a network that requires fragmentation?