IPv4, CIDR, and Fragmentation

1) An Internet Service Provider (ISP) has bought the right to use the IPv4 addresses in the range from 213.49.0.0 to 214.57.255.255. It uses Classless Inter-Domain Routing (CIDR) to route traffic to these addresses. It receives a number of requests from companies. First company A requests a block of 14,000 addresses, then company B requests 6,000, followed by company C with 850 addresses and company D requests 350 addresses. The ISP processes these requests in the order it receives them. What is the address range allocated for each client? Give the first and last address of the range, the number of significant bits and the subnet mask.

   If CIDR wasn't used, what classes of network addresses would be allocated to each client? How many addresses would be allocated in total? What would be the fraction of addresses actually used by each client? Compare this to the use of CIDR.

2) Assume you have a dial-up connection and want to send a UDP datagram of 5000 bytes to a server on the Internet. The connection between the two nodes that includes a PPP link with an MTU of 512 bytes, two Ethernet links with an MTU of 1500 bytes and an FDDI ring with an MTU of 4096 bytes. Draw a diagram of the connections, describe the fragmentation of the datagram as it is transferred to its destination and show the effect of the loss of a fragment. Contrast the behaviour of the 512-MTU-bytes dial-up link with 1500-MTU-bytes ADSL connection.

3) Assume that a node A intents to communicate with a node E over a number of intermediate nodes, B to D, as shown in figure 2. The IPv4 addresses and hardware addresses of the interfaces of the individual nodes are shown in figure 3. Node B acts as a NAT gateway.
   a) Describe the information that node B will keep in order to act as NAT gateway and how this information is used by B to process incoming and outgoing IPv4 packets.
   b) Describe the IPv4 packet that A would issue and the routing process of the IPv4 packet from A to E, at the intermediate hops.
   c) Describe the Link layer frames encapsulating the IPv4 packet assuming that all links use Ethernet and the resolution of the IPv4 addresses to Ethernet addresses at every hop.

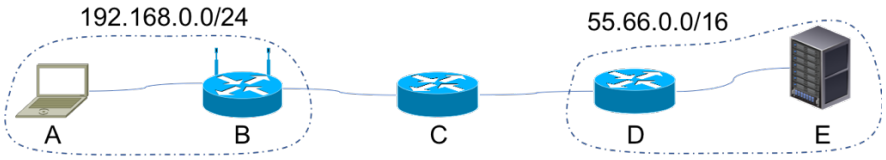
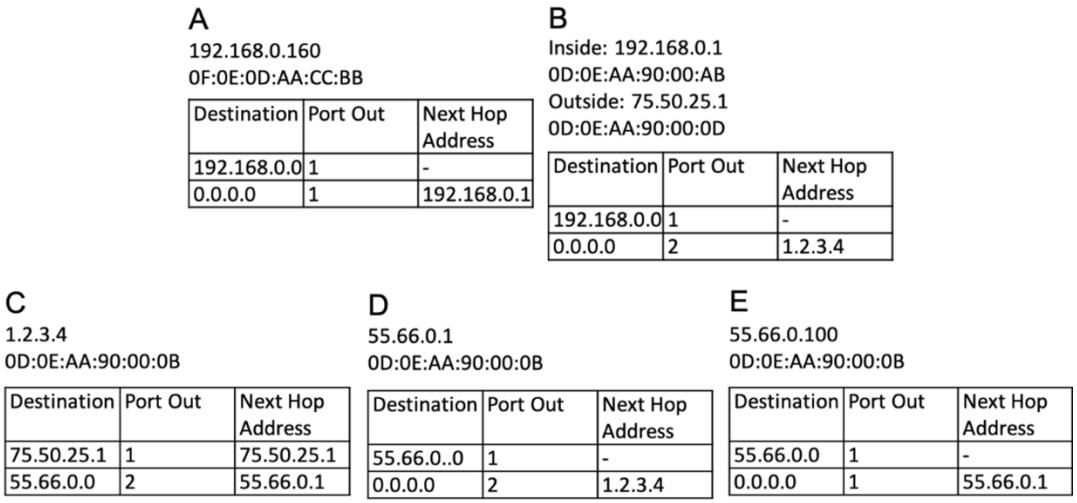


Figure 1: Topology with 5 nodes, A to E, that could represent a connection of a home network to a server over a 1-hop interconnecting network.



Destination	Port Out	Next Hop Address
192.168.0.0	1	-
0.0.0.0	1	192.168.0.1

Destination	Port Out	Next Hop Address
192.168.0.0	1	-
0.0.0.0	2	1.2.3.4

Destination	Port Out	Next Hop Address
75.50.25.1	1	75.50.25.1
55.66.0.0	2	55.66.0.1

Destination	Port Out	Next Hop Address
55.66.0..0	1	-
0.0.0.0	2	1.2.3.4

Destination	Port Out	Next Hop Address
55.66.0.0	1	-
0.0.0.0	1	55.66.0.1

Figure 2: IP addresses, hardware addresses and routing information of the nodes shown in figure 1.

4) The depletion of IPv4 addresses was a topic for discussions in the early 1990s. Discuss the causes for the depletion of these addresses and the effect that the use of CIDR and NAT had on address depletion.