IPv4 Addresses and Address Resolution Protocol

1) Your computer with the IP address 134.226.36.18 wants to transmit an IPv4 packet that contains a http-request to a server at Google with the IP address 173.194.37.104. Page 3 gives an overview of the topology; page 4 provides a template for a sequence diagram. For http-requests, your machine uses a proxy with the IP address 134.226.32.54. Your computer is connected through an IEEE 802.11 access point to the sub-network 134.226.36.0. The two sub-networks 134.226.36.0 and 134.226.32.0 are separate Ethernet broadcast domains, both of them are connected through a router in the School of Computer Science and Statistics with at least two interfaces, one with the IPv4 address 134.226.32.254 and another with the IPv4 address 134.226.36.254. The computers in the sub-networks use these addresses as the addresses for the default gateway i.e. computers in the subnet 134.226.36.0 will use the address 134.226.36.254 as their default gateway.

   Describe the journey of the IPv4 packet and the exchanges of information at the Network and Link Layer i.e. using IPv4, 802.11, and Ethernet from your computer to the server at Google. The description should include the information that is necessary for the computers and routers to process the IPv4 packets and Ethernet frames. You can assume that the routers have a full view of the internal network of TCD and do not have to update their routing information.

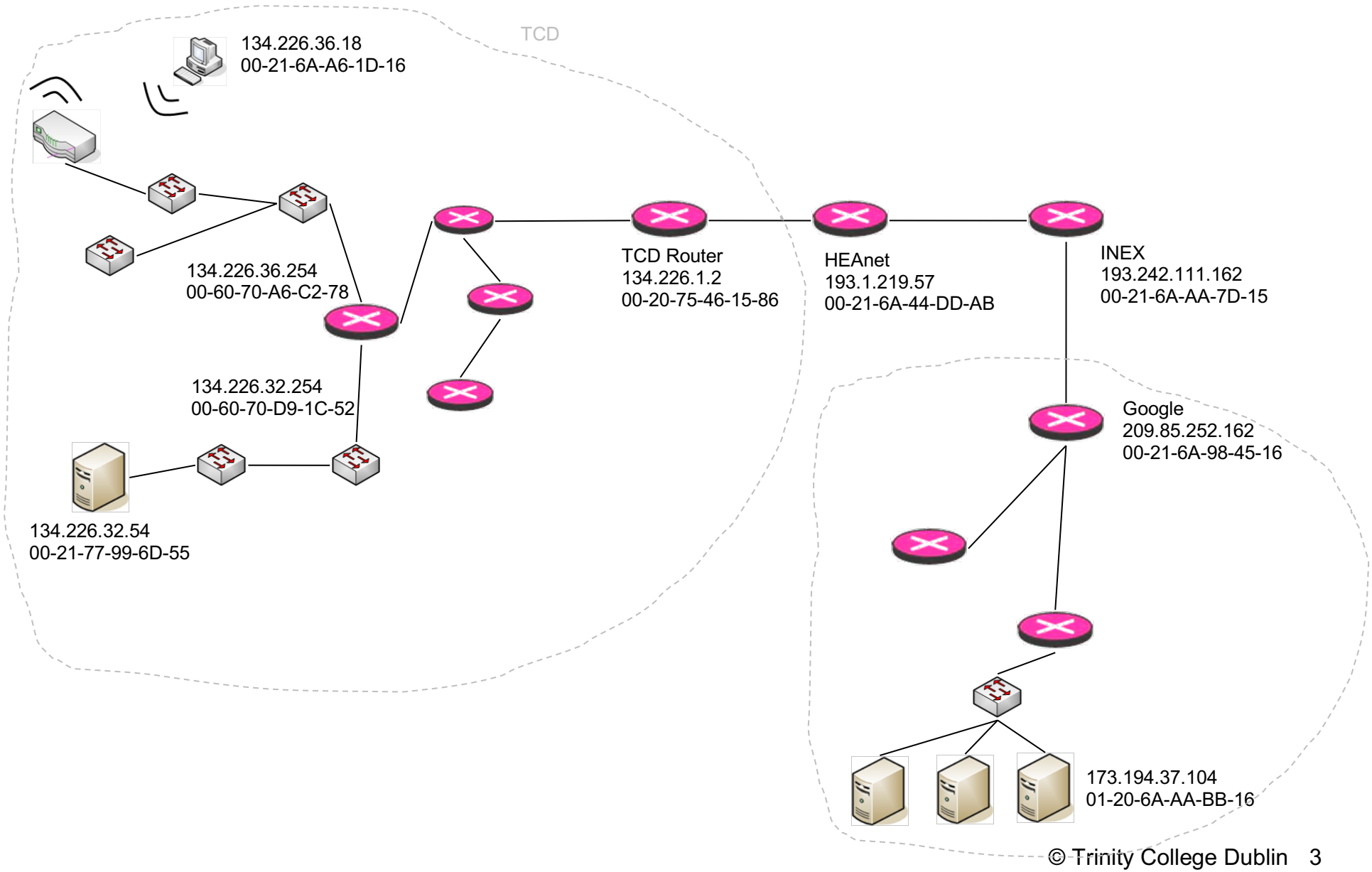
2) An Internet Service Provider (ISP) has bought the right to use the IPv4 addresses in the range from 213.49.0.0 to 214.57.255.255. It uses Classless Inter-Domain Routing (CIDR) to route traffic to these addresses. It receives a number of requests from companies. First company A requests a block of 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.

3) 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.

4) Assume that a local network with addresses in the range of 192.168.1.0-255 uses Network Address Translation (NAT) to communicate with nodes on the Internet through the address 208.125.22.15. Describe the processes that are used by NAT for this communication and discuss the limitation of NAT.

5) 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.


TCD
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134.226.36.254
00-60-70-A6-C2-78
134.226.32.254
00-60-70-D9-1C-52
134.226.32.54
00-21-77-99-6D-55
TCD Router
134.226.1.2
00-20-75-46-15-86
HEAnet
193.1.219.57
00-21-6A-44-DD-AB
INEX
193.242.111.162
00-21-6A-AA-7D-15
Google
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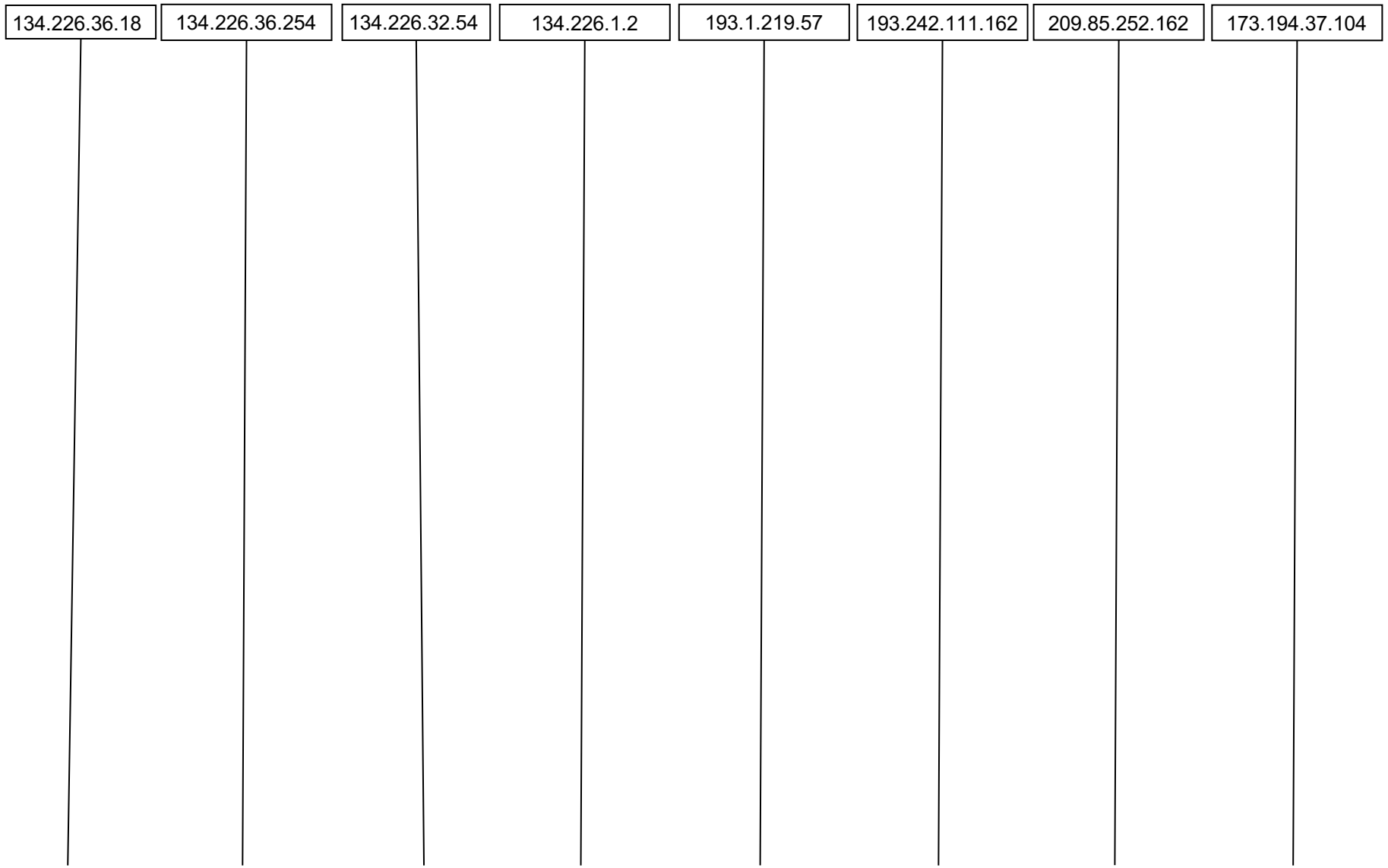
134.226.36.18
134.226.36.254
134.226.32.54
134.226.1.2
193.1.219.57
193.242.111.162
209.85.252.162
173.194.37.104