

# ECE 461 – Internetworking

## Problem Sheet 2

### Instructions (read carefully):

- Try to solve the problems on your own.
- Solutions will be discussed in tutorials.

**Problem 1.** Describe how class A, B, and C IP addresses are recognized in a binary representation of IP addresses ?

*Class A address start with “0”*

*Class B address start with “10”*

*Class C address start with “110”*

### Problem 2.

a) Why is a subnet of all zeros or all ones cannot be used in a classful routing environment?

*A subnet address of all zeroes cannot be used because a classful routing protocol has no way to differentiate between the all-zeroes subnet and the network address. (Example: Class B address 128.143.0.0 with subnetmask.255.255.255.0. Here, 128.143.0.0 can be interpreted as the address of the entire network (128.143.0.0/16) or subnetwork “0” on this network (128.143.0.0/24) )*

*A subnet address of all ones cannot be used because a classful routing protocol has no way to differentiate between the broadcast address on the subnet and the broadcast address on the entire network. (Example: Class B address 128.143.0.0 with subnetmask.255.255.255.0. Here, 128.143.255.255 can be interpreted as “all hosts on subnetwork 128.143.255.0” or the address “all hosts on network 128.143.0.0”)*

b) How many subnets are available if a class C address has six bits of subnetting? How many host addresses are available per subnet. (Hint: The problem statement of (a) contains a part of your answer.)

*With six bits of subnetting, a class C address will have  $2^6 - 2 = 62$  subnets and  $2^2 - 2 = 2$  host addresses per subnet.*

**Problem 3.** How would you express the entire Class B address space as a single CIDR advertisement?

*Since the leading two bits of all Class B addresses are “10”, the entire Class B address space can be expressed as 128/2.*

**Problem 4.** Assume that you have been assigned the 198.42.180.0/22 block of IP addresses.

- a) Specify an extended network prefix that allows the creation of 200 hosts on each subnet.
- b) With your answer to (a), what is the maximum number of hosts that can be assigned to each subnet?
- c) With your answer to (a), what is the maximum number of subnets that can be defined?
- d) Give the IP address (in CIDR notation) of one of these subnets. Give the broadcast address for this subnet.

(a) 8 bits are needed ( $2^8 > 200 > 2^7$ ) → Extended network prefix is /24 or 255.255.255.0

(b)  $2^8 - 2 = 254$  hosts (broadcast address and network address need to be subtracted)

(c)  $2^2 = 4$

(d) Here are all subnet addresses with network addresses

198.42.180.0/24, 198.42.180.255/24

198.42.181.0/24, 198.42.181.255/24

198.42.182.0/24, 198.42.182.255/24

198.42.183.0/24, 198.42.183.255/24

**Problem 5.** Aggregate the following set of four /24 IP network addresses to the highest degree possible.

212.56.132.0/24

212.56.133.0/24

212.56.134.0/24

212.56.135.0/24

- List each address in binary format and determine the common prefix for all of the addresses:

212.56.132.0/24 11010100.00111000.10000100.00000000

212.56.133.0/24 11010100.00111000.10000101.00000000

212.56.134.0/24 11010100.00111000.10000110.00000000

212.56.135.0/24 11010100.00111000.10000111.00000000

Common Prefix: 11010100.00111000.10000100.00000000

- The CIDR aggregation is:

212.56.132.0/22

**Problem 6.** Aggregate the following set of four /24 IP network addresses to the highest degree possible.

212.56.146.0/24

212.56.147.0/24

212.56.148.0/24

212.56.149.0/24

- List each address in binary format and determine the common prefix for all of the addresses:

212.56.146.0/24 11010100.00111000.10010010.00000000

212.56.147.0/24 11010100.00111000.10010011.00000000

212.56.148.0/24 11010100.00111000.10010100.00000000

212.56.149.0/24 11010100.00111000.10010101.00000000

- Note that this set of four /24s cannot be summarized as a single /23.

212.56.146.0/23 11010100.00111000.10010010.00000000

212.56.148.0/23 11010100.00111000.10010100.00000000

- The CIDR aggregation is:  
212.56.146.0/23  
212.56.148.0/23

Note that if two /23s are to be aggregated into a /22, then both /23s must fall within a single /22 block. Since each of the two /23s is a member of a different /22 block, they cannot be aggregated into a single /22 (even though they are consecutive). They could be aggregated into 222.56.144/21, but this aggregation would include four network numbers that were not part of the original allocation. Hence, the smallest possible aggregate is two /23s.