ECE 461 – Internetworking
Fall 2007

Problem Sheet 2

Discussed on: Sept. 24, 2006

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 wil l 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 entireClass 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
  212.56.148.0/24 11010100.00111000.10010101.00000000
- Note that this set of four /24s cannot be summarized as a single /23.
  212.56.146.0/23 11010100.00111000.1001001**0**.00000000
  212.56.148.0/23 11010100.00111000.1001010**0**.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.

Problem 7. 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 entireClass B address space can be expressed as 128/2.