Assignment: IP forwarding

Solutions

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

Problem 7. *(10 points)* **IP Routing Tables**

Consider the following routing table:

Network Destination	Next Hop
142.150.64.0/20	A
142.150.71.128/28	B
142.150.71.128/30	D
142.150.0.0/16	C

a. *(5 Points)* Assume that a router receives an IP datagram with destination 142.150.71.132. Determine the next hop of the IP datagram that is selected by the router? Explain you answer.

b. *(3 Points)* Add a routing table entry to the table above which enforces that all IP datagrams with destination 142.150.71.132 have "A" as Next Hop. For all other IP destination addresses, the Next Hop should not change.

c. *(2 Points)* Add a routing table entry to the table above which enforces that all IP datagrams whose destination address does not match any of the entries in the table, are forwarded to next hop "C". (The network destination for this entry must be provided as an network prefix)

(a)

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142.150.71.132    = 1000 1110.1001 0110.0100 0111.1000 0100
142.150.64.0/20   = 1000 1110.1001 0110.0100 0000.0000 0000
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142.150.71.128/28 = 1000 1110.1001 0110.0100 0111.1000 0000
142.150.71.128/30 = 1000 1110.1001 0110.0100 0111.1000 0000
142.150.0.0/16    = 1000 1110.1001 0110.0000 0000.0000 0000
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The bold digits show the bits of the prefix that need to match the destination address. The first, second and fourth entry match. The second entry has the longest matching prefix, so the next hop is **B.**

(b)
The routing table to be added is:

Network Destination	Next Hop
142.150.71.132/32	A

(c)
The routing table to be added is:

Network Destination	Next Hop
0.0.0.0/0	C