CSCD330 Computer Networks IP Address Subnetting Lab

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Background

Figuring out subnetting and masks is a useful skill for network engineers or others that need to configure networks. Working through examples will help us grasp the often confusing world of IP addressing and subnetting.

You might want to read one or two background articles before you tackle the Lab. It should be easy enough for you to figure out the answers.

Cisco Article, Subnet Chart for Easier Subnetting
Subnetting Secrets, Subnetting Secrets Link

Instructions

Do the following exercises by calculating subnets and hosts per subnet. Answer the questions at the end of the exercise. Applying a subnet mask means performing a bitwise AND of the mask and the IP Address.

Given an IP Address, Base Network Mask and Subnet Mask, how can you figure out:

- The subnet address of this subnet
- Broadcast address of this subnet
- Range of host addresses of this subnet

So, do the exercises below and generate the requested binary and IP results, plus the informational questions.

Question 1

Start with IP Address:

Host IP Address:	138.101.114.250
Major Network Mask:	255.255.0.0 (/16)
Subnet Mask:	255.255.255.192 (/26)

Determine Major Network Information

IP Address:	138.101.114.250
IP Address:	10001010 01100101 01110010 11111010
Network Mask:	255.255.0.0
Network Mask:	11111111 11111111 00000000 00000000

a. What is the BINARY of applying the Network Mask to the IP address?
   10001010 01100101 00000000 00000000
b. What is the corresponding IP address of this binary?
   138.101.0.0

To get the **broadcast address** of this network, change all 0's in host part to 1's.

Take the above result and put 1's in place of 0's in host part.

c. What is the binary representation of the broadcast address of the given IP address?
   10001010 01100101 11111111 11111111
d. What is the IP address of this broadcast address?
   138.101.255.255

Now, figure out how many hosts can be on this network.
Host bits: 16
Use the formula, $2^{16} - 2$. (Why? We reserve 1 IP address for the **base address** of the network, which is all 0's in the network portion and we reserve 1 IP address for the broadcast address of the network, which is all 1's.)

e. How many hosts can we put onto this network?
2^16 – 2 = 65534

Question 2

Now, let us look at figuring out the subnet address.

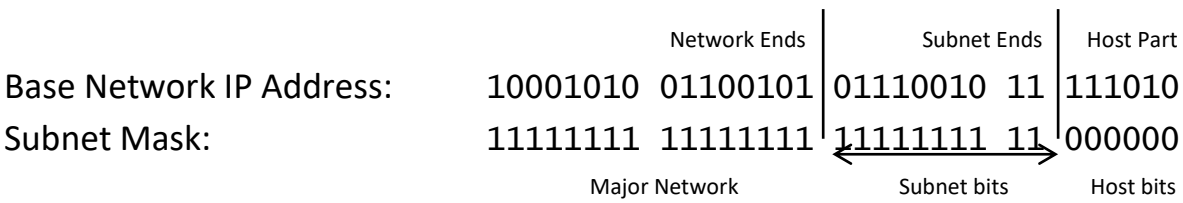
Take the original IP address of the major network and apply the Subnet Mask

IP Address:	138.101.114.250
IP Address :	10001010 01100101 01110010 11111010
Subnet Mask:	255.255.255.192
Network Mask:	11111111 11111111 11111111 11000000

a. What is the BINARY of applying the Network Mask to the IP address?
10001010 01100101 01110010 11000000
b. What is the corresponding IP address of this binary?
138.101.114.192

This is the base subnet address.

A couple more things to figure out. How many bits are dedicated to the subnet part of the address? You are going to count the number of 1's in the subnet mask beyond the base major network bits.



c. How many bits in the subnet part?
8 + 2 = 10

Next, figure out the number of hosts for this subnetwork.
For this calculation, you just count the number of host bits and use the formula below.

$2^{(\#host\ bits)} - 2 = Number\ of\ Hosts$

For example, if the host bits were 4, the answer would be, $2^4 - 2 = 14$.

d. How many hosts will this subnet support?
2^6 – 2 = 62

Next, determine the range of host addresses available on this subnet and the broadcast address on this subnet. In other words, what is the first IP address you can use for a host on this network?

IP Address :	10001010 01100101 01110010 11	111010
Mask:	11111111 11111111 11111111 11	000000
Host bits		

Make all host bits 0's except for least significant bit, which you make a 1. This is the first Host IP address on this subnet. Now, in the host portion make all host bits 1's except for rightmost bit, which you make a 0. (Hint, it is one less than the broadcast address of the subnetwork.) This is the last host on this subnetwork. Then, make all bits 1's in host part, which is the Broadcast Address of this subnetwork.

e. First IP Address of Host on subnetwork
10001010 01100101 01110010 11000001 = 138.101.114.193
f. Last IP Address of Host on subnetwork
10001010 01100101 01110010 11111110 = 138.101.114.254
g. Broadcast Address of subnetwork
10001010 01100101 01110010 11111111 = 138.101.114.255

Finally, determine the number of Usable Subnets. This is done by taking the number of subnet bits you determined in answer 2d. This again is the number of bits beyond the major network bits but not the host bits.
Take the answer in 2d, and plug it into the formula

$2^{(\#subnet\ bits)} - 1 = Usable\ Subnets$

Turns out the last subnet of all 1's is not used but the first subnet of all 0's is used.

h. How many usable subnets are there for this configuration?
2^10 – 1 = 1023

Last, to determine the number of hosts per subnetwork, count the number of host bits, and plug it into this formula,

$$2^{(\#\text{host bits})} - 2 = \text{Hosts}$$

Again, you can't use the broadcast address for a single host IP and you can't use the base subnet address for a single host.

i. How many hosts per subnet?
2^6 – 2 = 62

General Questions

3. What is the benefit of subnetting? Is there a benefit?
From observation, subnetting can be a good way of organizing and configuring groups of hosts and networks in one place for organizations that need it, but is pretty useless for things like personal use.

4. Briefly, what is the benefit of CIDR over Classful addressing?
CIDR allows for higher flexibility and better organization and configuration capabilities of larger networks, and networks no longer needed to fit into "classes" to prevent exhausting free IP addresses.