## Unit 3 Subnetting Lab 3

Read the lab details listed below, and then answer the questions listed in the lab exercise.

Using the Ellis Methodology of Subnetting “EMS”

“EMS” Simplified Method Class C

This is a simplified method of subnetting by **remembering** a few basic rules. Network **Host**

1. You are only subnet the host octet or last octet, as in 192.168. 3 . **5**
2. In basic subnetting, you don’t use the first IP value as it’s the network address, and you don’t use the last IP value as it’s the broadcast address.
3. Identify the value of each bit in an octet beginning with 1 and multiplying it by 2 for each bit place in an octet as illustrated below in line 1 below.
4. Subtract your first and last IP values from each bit value in line 1 or take 2 from each place, as illustrated in line 2 below. If you can’t take 2 from 1, leave it blank.
5. Reverse the numbers starting with 0 and place it under 126 of line 2 and continue until 126 is under the zero of line 2, as illustrated in line 3 below.
6. As you borrow bits from the left you decrease the number of available hosts as you increase the number of available networks. So, the hosts, line 2, decrease as the sub-networks, line 3, increase.
7. Now for any Cisco IOS above 12.0 remember to add two to each value in line 3 as we gain those networks back in the new version. If use an older IOS, leave the values as indicated in the chart.
8. Line or row 1 identifies the quantity of IP addresses for each subnet in total. Line or row 2 identifies how many hosts can exist in the subnetted range, and line or row 3 identifies how many subnets can exist in the subnetted range.
9. A way to remember what each line represents use the first letter from each line I, H and S and just remember “I Hate Sub-Netting.”

Class C Subnetting Guide

Line 1. **“IP’s”** 128 64 32 16 8 4 2 1

Line 2. **“Hosts”** 126 62 30 14 6 2 0

Line 3. **“Subnets”** 0 2 6 14 30 62 126

Now that you have your Class C “Cheat Sheet,” remember that by using this guide you can subnet any Class C IP address. Remember that the values on line 2 are the number of usable hosts and the values on line 3 are the number of usable sub-networks created when borrowing the bits across the values on line 1 from left to right. That is because we took away both the network IP and broadcast IP from each. You can add two back to each value in lines 2 and 3 to know how many actual hosts and networks are actually created. This is for IOS 11.0 and older.

We begin by giving up bits from left to right starting with the 128 bit and moving right to get the subnet range we want. If we want 30 host computers on each of the six subnetworks, we would give up the 128, the 64, and the 32-bit values of line 1; which is the host values of that octet. This means, we would borrow those three bits. We would identify this by drawing a line down from the 32 past the 30 to the 6 as indicated in the example below.

To get the subnet mask, simply add the values of each bit you borrowed from left to right on line 1. If you add 128 and 64 and 32 together you get 224. Now the new subnet mask is 255.255.255.224

Example

 In this example, we are borrowing the first 3 bits in the 4th octet to give up to subnetting.

1. 4th Octet bit representation 128 64 **32** | 16 8 4 2 1 **“IP’s”**

2. Subtract First & Last 126 62 **30** | 14 6 2 0 **“Hosts”**

3. Reverse of Line 2 0 2  **6** | 14 30 62 126 **“Subnets”**

Again, if you wanted to create a subnet with 30 hosts on each of six subnetworks as indicated above, you would borrow the first three bits, always from the left.

We started with a Class C default mask of 255.255.255.0 To get a new subnet mask we add the values of the three bits that are used: 128 + 64 + 32 = 224.

That would give us a subnet mask of 255.255.255.224 where the 255 represents the value for the other octets.

Next to get the allocated IP addresses for each subnet, notice the number 32 in the column you took the bits to. This identifies how many IP are in each subnet. Each of the subnets are in groups of 32 IP addresses as indicated by the table below.

This is created by starting with 0, go vertically “down” in groups of 32 as indicated here:

 0

 32

 64

 96

 Etc. to 255 as shown in Table 1 below

This is the first bit value in each of the new subnet ranges. Now fill in the last value for each subnet range by realizing that it will be one less than the start of the next range as indicated here:

0------------31

 32----------63

 64----------95

 96---------127

 Etc. to 255 as shown in Table 1 below

**Table 1:**

|  |  |  |  |
| --- | --- | --- | --- |
| **Subnet**  | **Network Number** | **Host IP Range** | **Usable IP Range** |
| Subnet 1 | 192.168.1 | 0-------------31 | 1-30 “First Usable Subnet Range” |
| Subnet 2 | 192.168.1 | 32------------63 | 33-62  |
| Subnet 3 | 192.168.1 | 64------------95 | 65-94 |
| Subnet 4 | 192.168.1 | 96-----------127 | 97-126 |
| Subnet 5 | 192.168.1 | 128---------159 | 129-158 |
| Subnet 6 | 192.168.1 | 160---------191 | 161-190 |
| Subnet 7 | 192.168.1 | 192---------223 | 193-222  |
| Subnet 8 | 192.168.1 | 224---------255 | 225-254 “Last Usable Subnet Range” |

Remember that we can’t use either the first value in a network range (it’s reserved as the network number value) or the last value in a network range (it’s reserved as the network broadcast value).

So, from Table 1 above, we can see that:

* The IP address, 192.168.1.1 in subnet range 1 is the first usable address in that subnet range.
* The IP address, 192.168.1.30 in subnet range 1, is the last usable address in that subnet range.
* The IP address, 192.168.1.225 in subnet range 8, is the first usable address in that subnet range.
* The IP address, 192.168.1.254 in subnet range 8, is the last usable address in that subnet range.

The same is true for all of the other ranges between them.

Note that the values in the host IP range are the values available for the host addresses in the 4th octet. Also, those values identify both the network value and the broadcast value for each of the subnets.

The values indicated in the usable IP range are the specific IP addresses usable only on that subnet.

## Subnetting Lab 3 Exercise

Using the Ellis method of subnetting and using the Class C Subnetting Guide, answer the following:

Given an IP address of 192.168.0.1 use the guide to get 12 hosts on each of your 12 networks:

1. What Class is this IP address? \_\_\_\_\_
2. How many bits would you borrow or take? \_\_\_\_\_\_\_
3. What subnet mask would you generate? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
4. What is the first subnetwork range created? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
5. What is the last subnetwork range created? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Given an IP address of 192.168.1.1 use the guide to get five hosts on each of your 25 networks:

1. What Class is this IP address? \_\_\_\_\_
2. How many bits would you borrow or take? \_\_\_\_\_\_\_
3. What subnet mask would you generate? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
4. What is the first subnetwork range created? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
5. What is the last subnetwork range created? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Given an IP Address of 192.168.1.1 use the guide to get 60 hosts on each of your 2 networks:

1. What Class is this IP address? \_\_\_\_\_
2. How many bits would you borrow or take? \_\_\_\_\_\_\_
3. What subnet mask would you generate? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
4. What is the first subnetwork range created? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
5. What is the last subnetwork range created? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_