



Appendices Lab- 10 Subnetting

LEARNING OBJECTIVE:



- Upon completion of this activity, you will be able to determine network information for a given IP address and network mask.

Subnetting Basics

- There are lots of reasons in favor of subnetting, including the following benefits:
 - **Reduced network traffic**
 - **Optimized network performance**
 - **Simplified management**
 - **Facilitated spanning of large geographical distances**
 - **Better Security**
 - By splitting your network into subnets, you can control the flow of traffic using ACLs, QoS, or route-maps, enabling you to identify threats, close points of entry, and target your responses more easily.

What is Subnet

- Subnetting is basically just a way of splitting a TCP/IP network into smaller, more manageable pieces.
- If you have an excessive amount of traffic flowing across your network, then that traffic can cause your network to run slowly.
- So, when you subnet your network, you are splitting the network into a separate, but interconnected network.
- The values in the subnet mask identify how many hosts can exist on the subnet.

How to Create Subnets

- To create sub networks, you take bits from the host portion of the IP address and reserve them to define the subnet address



Steps to create subnets

1. Determine the number of required network IDs:
 - One for each LAN subnet
 - One for each wide area network connection
2. Determine the number of required host IDs per subnet:
 - One for each TCP/IP host
 - One for each router interface
3. Based on the above requirements, create the following:
 - One subnet mask for your entire network
 - A unique subnet ID for each physical segment
 - A range of host IDs for each subnet

Subnet Mask

- Subnet mask is 32-bit number that masks an IP address
- Subnet mask separates the IP address into the network and host address
- Subnet mask is made by setting network bits to all 1's and setting all host bits to all 0's
- Two addresses are reserved "0" address assigned to network address and "255" is assigned to broadcast address

Table 4-1: Default subnet mask

Class	Format	Default Subnet Mask
A	network.node.node.node	255.0.0.0
B	network.network.node.node	255.255.0.0
C	network.network.network.node	255.255.255.0

Subnetting Class C IP addresses

- In class-C only 8-bits are available for defining the hosts
- How many subnets does the chosen subnet mask produce?
- How many valid hosts per subnet are available?
- What are the valid subnets?
- What's the broadcast address of each subnet?
- What are the valid hosts in each subnet?

Subnetting Class C IP addresses

1. 2^x x is the number of masked bits or the 1's
2. For example 10000000
 - The no. of 1's gives us 2^1 subnets, there are 2 subnets
3. How many hosts per subnet
 - $2^y - 2 =$ no. of hosts per subnet
 - y is the no. of unmasked bits or 0's
4. 10000000, $2^7 - 2$, in this there are 126 hosts per subnet
5. Valid subnet ? Block size = 256 – subnet mask
6. For example $256 - 128 = 128$, the block size of a 128 mask is always 128

Subnetting of Class-C

/25 What do we know about a /25?

- 128 mask
- 1 bit on and 7 bits off (10000000)
- Block size of 128
- 2 subnets, each with 126 hosts

/26 What do we know about a /26?

- 192 mask
- 2 bits on and 6 bits off (11000000)
- Block size of 64
- 4 subnets, each with 62 hosts

/27 What do we know about a /27?

- 224 mask
- 3 bits on and 5 bits off (11100000)
- Block size of 32
- 8 subnets, each with 30 hosts

Subnetting of Class-C

/28 What do we know about a /28?

- 240 mask
- 4 bits on and 4 bits off
- Block size of 16
- 16 subnets, each with 14 hosts

/29 What do we know about a /29?

- 248 mask
- 5 bits on and 3 bits off
- Block size of 8
- 32 subnets, each with 6 hosts

/30 What do we know about a /30?

- 252 mask
- 6 bits on and 2 bits off
- Block size of 4
- 64 subnets, each with 2 hosts

Subnetting of Class-B IP addresses

Subnetting Practice Examples: Class B Addresses

The following sections will give you an opportunity to practice subnetting Class B addresses. Again, I have to mention that this is the same as subnetting with Class C, except we start in the third octet—with the exact same numbers!

Practice Example #1B: 255.255.128.0 (/17)

172.16.0.0 = Network address

255.255.128.0 = Subnet mask

- *Subnets?* $2^1 = 2$ (same as Class C).
- *Hosts?* $2^{15} - 2 = 32,766$ (7 bits in the third octet, and 8 in the fourth).
- *Valid subnets?* $256 - 128 = 128$. 0, 128. Remember that subnetting is performed in the third octet, so the subnet numbers are really 0.0 and 128.0, as shown in the next table. These are the exact numbers we used with Class C; we use them in the third octet and add a 0 in the fourth octet for the network address.
- *Broadcast address for each subnet?*
- *Valid hosts?*

The following table shows the two subnets available, the valid host range, and the broadcast address of each:

Subnet	0.0	128.0
First host	0.1	128.1
Last host	127.254	255.254
Broadcast	127.255	255.255

Example # 02

Practice Example #2B: 255.255.192.0 (/18)

172.16.0.0 = Network address

255.255.192.0 = Subnet mask

- *Subnets?* $2^2 = 4$.
- *Hosts?* $2^{14} - 2 = 16,382$ (6 bits in the third octet, and 8 in the fourth).
- *Valid subnets?* $256 - 192 = 64$. 0, 64, 128, 192. Remember that the subnetting is performed in the third octet, so the subnet numbers are really 0.0, 64.0, 128.0, and 192.0, as shown in the next table.
- *Broadcast address for each subnet?*
- *Valid hosts?*

The following table shows the four subnets available, the valid host range, and the broadcast address of each:

Subnet	0.0	64.0	128.0	192.0
First host	0.1	64.1	128.1	192.1
Last host	63.254	127.254	191.254	255.254
Broadcast	63.255	127.255	191.255	255.255

Again, it's pretty much the same as it is for a Class C subnet—we just added 0 and 255 in the fourth octet for each subnet in the third octet.

Example 03

Practice Example #4B: 255.255.254.0 (/23)

172.16.0.0 = Network address

255.255.254.0 = Subnet mask

- *Subnets?* $2^7 = 128$.
- *Hosts?* $2^9 - 2 = 510$.
- *Valid subnets?* 256 - 254 = 0, 2, 4, 6, 8, etc., up to 254.
- *Broadcast address for each subnet?*
- *Valid hosts?*

The following table shows the first five subnets, valid hosts, and broadcast addresses in a Class B 255.255.254.0 mask:

Subnet	0.0	2.0	4.0	6.0	8.0
First host	0.1	2.1	4.1	6.1	8.1
Last host	1.254	3.254	5.254	7.254	9.254
Broadcast	1.255	3.255	5.255	7.255	9.255

Example 04

Practice Example #5B: 255.255.255.0 (/24)

Contrary to popular belief, 255.255.255.0 used with a Class B network address is not called a Class B network with a Class C subnet mask. It's amazing how many people see this mask used in a Class B network and think it's a Class C subnet mask. This is a Class B subnet mask with 8 bits of subnetting—it's logically different from a Class C mask. Subnetting this address is fairly simple:

172.16.0.0 = Network address

255.255.255.0 = Subnet mask

- *Subnets?* $2^8 = 256$.
- *Hosts?* $2^8 - 2 = 254$.
- *Valid subnets?* 256 – 255 = 1. 0, 1, 2, 3, etc., all the way to 255.
- *Broadcast address for each subnet?*
- *Valid hosts?*

The following table shows the first four and last two subnets, the valid hosts, and the broadcast addresses in a Class B 255.255.255.0 mask:

Subnet	0.0	1.0	2.0	3.0	...	254.0	255.0
First host	0.1	1.1	2.1	3.1	...	254.1	255.1
Last host	0.254	1.254	2.254	3.254	...	254.254	255.254
Broadcast	0.255	1.255	2.255	3.255	...	254.255	255.255

Example 05

Practice Example #6B: 255.255.255.128 (/25)

This is one of the hardest subnet masks you can play with. And worse, it actually is a really good subnet to use in production because it creates over 500 subnets with 126 hosts for each subnet—a nice mixture. So, don't skip over it!

172.16.0.0 = Network address

255.255.255.128 = Subnet mask

- *Subnets?* $2^9 = 512$.
- *Hosts?* $2^7 - 2 = 126$.
- *Valid subnets?* Okay, now for the tricky part. $256 - 255 = 1$. 0, 1, 2, 3, etc. for the third octet. But you can't forget the one subnet bit used in the fourth octet. Remember when I showed you how to figure one subnet bit with a Class C mask? You figure this the same way. (Now you know why I showed you the 1-bit subnet mask in the Class C section—to make this part easier.) You actually get two subnets for each third octet value, hence the 512 subnets. For example, if the third octet is showing subnet 3, the two subnets would actually be 3.0 and 3.128.
- *Broadcast address for each subnet?*
- *Valid hosts?*

The following table shows how you can create subnets, valid hosts, and broadcast addresses using the Class B 255.255.255.128 subnet mask (the first eight subnets are shown, and then the last two subnets):

Subnet	0.0	0.128	1.0	1.128	2.0	2.128	3.0	3.128	...	255.0	255.128
First host	0.1	0.129	1.1	1.129	2.1	2.129	3.1	3.129	...	255.1	255.129
Last host	0.126	0.254	1.126	1.254	2.126	2.254	3.126	3.254	...	255.126	255.254
Broadcast	0.127	0.255	1.127	1.255	2.127	2.255	3.127	3.255	...	255.127	255.255

Example 06

Practice Example #8B: 255.255.255.224 (/27)

This is done the same way as the preceding subnet mask, except that we just have more subnets and fewer hosts per subnet available.

172.16.0.0 = Network address

255.255.255.224 = Subnet mask

- *Subnets?* $2^{11} = 2048$.
- *Hosts?* $2^5 - 2 = 30$.
- *Valid subnets?* $256 - 224 = 32$. 0, 32, 64, 96, 128, 160, 192, 224.
- *Broadcast address for each subnet?*
- *Valid hosts?*

The following table shows the first eight subnets:

Subnet	0.0	0.32	0.64	0.96	0.128	0.160	0.192	0.224
First host	0.1	0.33	0.65	0.97	0.129	0.161	0.193	0.225
Last host	0.30	0.62	0.94	0.126	0.158	0.190	0.222	0.254
Broadcast	0.31	0.63	0.95	0.127	0.159	0.191	0.223	0.255

This next table shows the last eight subnets:

Subnet	255.0	255.32	255.64	255.96	255.128	255.160	255.192	255.224
First host	255.1	255.33	255.65	255.97	255.129	255.161	255.193	255.225
Last host	255.30	255.62	255.94	255.126	255.158	255.190	255.222	255.254
Broadcast	255.31	255.63	255.95	255.127	255.159	255.191	255.223	255.255