subnetting – a faster approach

Most subnetting problems sound like this:

Given an IP address and a CIDR number (like **172.16.10.33/27**), find:

> 1. the subnet (the subnet ID)
>
> 2. the broadcast address
>
> 3. the valid host range

In other problems, we have to find, as well:

> 4. the number of subnets within a network
>
> 5. the number of hosts within a subnet

How do we start?

step 1. Find n, c, x, y

Remember that the 32 bits of an IPv4 address are split into 3 parts: **n + x + y = 32**.

a) Find **n** first. The most significant n bits are used to identify the network class, and can have the values 8, 16, 24 for class A, B and C, respectively.

How do we know which class? We look at the first byte of the IP address. Class A IP addresses have the first byte in the range 0-127 (1-126 in real life), class B in the range 128-191 and class C in the range 192-223.

In our case the first byte is 172, class B, this means that **n = 16**.

b) **c** is the CIDR number, the number after the slash. In our case, **c = 27**.

c) because, by definition, c = n + x, we have that **x = c – n**. In our case, **x = 27-16 = 11**.

d) finally, **y = 32 – c**. In our case, **y = 32 – 27 = 5**.

step 2. Write the CIDR byte in binary format (base 2)

The **CIDR byte** is the byte where the c(+1)-th bit lies (counting from left to right). For example, if c = CIDR = 22, that would be the third byte. In our case, when CIDR = 27, that is the fourth (the last) byte.

Ok, so let's write the last byte of the given IP address in binary format, keeping the other bytes in the existing format (decimal). We get, since 33 = 32 + 1:

172.16. 10. **0010 0001**

step 3. Find the subnet ID

For that, we set all host bits (the last y bits, that's the last 5 in our case) equal to 0. We get:

172.16.10. 001**0 0000**

So, the **subnet ID** is **172.16.10.32**.

step 4. Find the broadcast address

For that, we set all host bits (the last y bits, that's the last 5 in our case) equal to 1. We get:

172.16.10. 001**1 1111**

So, the **broadcast address** is **172.16.10.63**.

step 5. **Find the valid host range**

The valid host range is the open interval (both ends excluded) between the subnet ID and the broadcast address. In our case:

The valid host rage is **172.16.10.33 – 172.16.10.62**.

steps 6, 7. If required, find the number of subnets and the number of hosts in each subnet

Number of subnets = 2^x. In our case **2^{11} = 2048**.

Number of hosts = 2^y - 2. In our case **2^5 – 2 = 30**.

subnetting fast, 3 examples

These 3 examples are taken from the CCNA study guide, ed 6. Written Lab 3.3, page 160/200.

Example 1. 192.168.20.123/28.

step 1. n = 24 (class C), x = c – n = 28 – 24 = 4, y = 32 – c = 32 – 28 = 4.

step 2. bit 28 is in the last byte, rewrite the IP address as: 192.168.20. **0111 1011**

step 3. the subnet ID is 192.168.20. 0111 **0000** = **192.168.20.112**

step 4. the broadcast address is 192.168.20. 0111 **1111** = **192.168.20.127**

step 5. the valid host range is **192.168.20.113 - 192.168.20.126**

step 6. the number of subnets is 2^x = 2^4 = **16**.

step 7. the number of hosts (within a subnet) is 2^y - 2 = 2^4 - 2 = **14**.

Example 2. 172.31.254.12/24.

step 1. n = 16 (class B), x = c – n = 24 – 16 = 8, y = 32 – c = 32 – 24 = 8.

step 2. bit 24 is in the third byte, but since this byte will not change, let's choose the next byte, where the (c+1)-th bit lies), rewrite the IP address as: 172.31.254. **0000 1100**

step 3. the subnet ID is 172.31.254. **0000 0000** = **172.31.254.0**

step 4. the broadcast address is 172.31.254. **1111 1111** = **172.31.254.255**

step 5. the valid host range is **172.31.254.1 - 172.31.254.254**

step 6. the number of subnets is 2^x = 2^8 = **256**.

step 7. the number of hosts (within a subnet) is 2^y - 2 = 2^8 - 2 = **254**.

Example 3. 63.24.89.21/18

step 1. n = 8 (class A), x = c – n = 18 – 8 = 10, y = 32 – c = 32 – 18 = 14.

step 2. bit 18 is in the third byte, rewrite the IP address as: 63.24. **0101 1001** .21

step 3. the subnet ID is 63.24. 01**00 0000** .**0 = 63.24.64.0**

step 4. the broadcast address is 63.24. 01**11 1111 .255 = 63.24.127.255**

step 5. the valid host range is **63.24.64.1 - 63.24.127.254**

step 6. the number of subnets is 2^x = 2^10 = **1024**.

step 7. the number of hosts (within a subnet) is 2^y - 2 = 2^14 - 2 = **16384**.