IP AND SUBNETTING

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DW1E – 15-05-2022

IP AND SUBNETTING EXERCISES

1. Write the subnet, broadcast address and valid host range for the following:
   a. 192.168.100.17, with 4 bits of subnetting
   b. 192.168.100.66, with 3 bits of subnetting
   c. 172.16.10.5/20
   d. 172.16.10.33/255.255.252.0

a. 192.168.100.17, with 4 bits of subnetting.

The first thing we need to do is know the IP address class. To do this we have to use the first bits on the left of the first octet. We have to convert the decimal notation to binary.

11000000 -> This means this is class C.

255.255.255.0-> This is the general mask for this class C.

Now, we need 4 extra bits of subnetting to represent the network. In order to do this, we have to convert the general mask from decimal notation to binary.

11111111.11111111.11111111.11110000

255.255.255.240-> This is the subnet mask in decimal.

The first three octets represent the network and last octet the hosts. So, to calculate the subnet and broadcast address we need to perform the calculations of the last 8 binary digits.

192.168.100.**00010001**

Now, we are going to calculate the network. We keep 4 bits of subnetting and the hosts ones will be 0s.

192.168.100.0001**0000**
Hosts

After that, we convert this binary octet into decimal and this will be the **network**. We have to sum all the 1s of the last octet.

192.168.100.16

Then, to calculate the **broadcast address**, we have to convert the four last bits of the last octet to 1s and sum all the 1s of the last octet.

192.168.100.0001**1111**-> 16+8+4+2+1-> 31 -> **192.168.100.31**

To obtain the **range of hosts**, we have to discard the network and broadcast addresses. So, we have **14 hosts** from **192.168.100.17** to **192.168.100.30**. We also can use this formula to calculate the number of hosts: (2 to the n power minus 2) 2^4 - 2 = 16 – 2 = 14 hosts.

b. 192.168.100.66, with 3 bits of subnetting.

Another way to do the same as exercise a:
The first thing we need to do is know the IP address class. To do this we have to use the first bits on the left of the first octet. We have to convert the decimal notation to binary.

11000000.10101000.011001000.**010**00010
Class C Subnet

11111111.11111111.11111111.00000000 -> General mask for class C in binary.
255.255.255.0 -> This is the general mask for class C in decimal.

Now, we need 3 extra bits of subnetting to represent the network. In order to do this, we have to convert the general mask from decimal notation to binary.

11111111.11111111.11111111.11100000 -> This is the subnet in binary.
255.255.255.224 -> This is the subnet in decimal.

The first three octets represent the network and last octet the hosts. So, to calculate the subnet and broadcast address we need to perform the calculations of the last 8 binary digits.

11000000.10101000.011001000.**01000010**

Now, we are going to calculate the network. We keep 3 bits of subnetting and the hosts ones will be 0s. We have to sum all the 1s of the last octet.

11000000.10101000.011001000.010**00000** -> This is the network in binary.
192.168.100.64 -> This is the network in decimal.

Then, to calculate the **broadcast address**, we have to convert the five last bits of the last octet to 1s and sum all the 1s of the last octet.

11000000.10101000.011001000.010**11111** ->64+16+8+4+2+1 -> 95. This is the broadcast in binary.

192.168.100.95 -> This is the broadcast in decimal.

To obtain the **range of hosts**, we have to discard the network and broadcast addresses. So, we have **30 hosts** from **192.168.100.64** to **192.168.100.94**. We also can use this formula to calculate the number of hosts: (2 to the n power minus 2) 2^5 - 2 = 32 – 2 = 30 hosts.

c. 172.16.10.5/20

The first thing we need to do is know the IP address class. To do this we have to use the first bits on the left of the first octet. We have to convert the decimal notation to binary.

10101100.00010000.00001010.00000101
Class B

We have the two first octets for the network and the two last octets for hosts and 4 more bits of the third octet as subnet because is /20.

255.255.0.0 -> This is the general mask for class B

Now, we need 4 extra bits of subnetting to represent the network. In order to do this, we have to convert the general mask from decimal notation to binary.

255.255.**1111**0000.00000000
255.255.240.0 -> This is the subnet mask

The first two octets represent the network and last two octet the hosts. So, to calculate the subnet and broadcast address we need to perform the calculations of the last 16 binary digits.

172.16.**00001010.00000101**

Now, we are going to calculate the network. We keep 4 bits of subnetting and the hosts ones will be 0s.

172.16.0000**0000.00000000**
Hosts

After that, we convert this binary octet into decimal and this will be the **network**.

172.16.0.0 -> This is the network

Then, to calculate the **broadcast address**, we have to convert the twelve last bits of the last two octets to 1s and sum all the 1s of the last two octets.

172.16.0000**1111.11111111**

172.16.15.255 -> This is the broadcast address

To obtain the **range of hosts**, we have to discard the network and broadcast addresses. So, we have **4094 hosts** from **172.16.0.1** to **172.16.15.254**. We also can use this formula to calculate the number of hosts: (2 to the n power minus 2) 2^{12} - 2 = 4096 – 2 = 4094 hosts.

d. 172.16.10.33/255.255.252.0

In this case, we have the host and the mask. The first thing we need to do is know the IP address class. To do this we have to use the first bits on the left of the first octet. We have to convert the decimal notation to binary.

10101100.00010000.00001010.00100001 -> Class B

We have the two first octets for the network and the two last octets for hosts and 6 more bits of the third octet as subnet because is /22.

255.255.0.0 -> This is the general subnet for class B

Now, we need 6 extra bits of subnetting to represent the network. In order to do this, we have to convert the general mask from decimal notation to binary.

255.255.**11111**00.00000000 / **255.255.252.0** -> Subnet mask

The first two octets and 6 bits of the third octet represent the network and last two bits of the third octet and the last one represent the hosts. So, to calculate the subnet and broadcast address we need to perform the calculations of the last 16 binary digits.

172.16.**00001010.00100001**

Now, we are going to calculate the network. We keep 6 bits of subnetting and the hosts ones will be 0s.

172.16.000010**00.00000000**

After that, we convert this binary octet into decimal and this will be the **network**. We have to sum all the 1s of the third octet.

172.16.8.0 -> This is the network

Then, to calculate the **broadcast address**, we have to convert the twelve last bits of the last two octets to 1s and sum all the 1s of the last two octets.

172.16.000010**11.11111111**

172.16.11.255 -> This is the broadcast address

To obtain the **range of hosts**, we have to discard the network and broadcast addresses. So, we have **1022 hosts** from **172.16.8.1** to **172.16.11.254**. We also can use this formula to calculate the number of hosts: (2 to the n power minus 2) 2^{10} - 2 = 1024 – 2 = 1022 hosts.

2. You have been asked to create a subnet that supports 126 hosts. What subnet mask is the most efficient one?

We use this formula to obtain the possible combinations: $2^n - 2$, so $2^7 - 2 = 128 - 2 = 126$. The 1s in the mask represent the bits of subnet and the 0s represent the bits of hosts.

11111111.11111111.11111111.10000000

255.255.255.128/25

3. Given the following information:

a. Network address: 192.168.10.0
b. Subnet mask: 255.255.255.192

How many subnets are there? How many hosts? What are the valid subnets?

192.168.10.0 is a Class C IP address. The general mask for this class is **255.255.255.0**.

This is the subnet mask 255.255.255.11000000/26

To calculate the different subnetworks, we need to use all the combinations. The first three octets are class C and will be fixed.

1. 00000000 = 0
2. 01000000 = 64 -> This is the magic number because we add 64 to calculate the IP address of the different subnetworks.
3. 10000000 = 128
4. 11000000 = 192

The procedure to calculate the broadcast address is the same as exercise 1 (the 6 bits for the hosts are 1s):

1. 192.168.10.**00**000000 -> **192.168.0.0/26** and broadcast **192.168.10.63**
   192.168.10.00111111 -> valid host range from **192.168.10.1** to **192.168.10.62**.

2. 192.168.10.**01**000000 -> **192.168.0.64/26** and broadcast **192.168.10.127**
   192.168.10.01111111-> valid host range from **192.168.10.65** to **192.168.10.126**

3. 192.168.10.**10**000000 -> **192.168.10.128/26** and broadcast **192.168.10.191**
   192.168.10.10000000-> valid host range from **192.168.10.129** to **192.168.10.190**

4. 192.168.10.**11**000000 -> **192.168.10.192/26** and **192.168.10.255**
   192.168.10.11111111-> valid host range from **192.168.10.193** to **192.168.10.254**

4. (Exercise 5) XYZ Company would like to subnet its network so that there are five separate subnets. They will need 25 computers in each subnet. Complete the following table: NOTE: If you create more than five subnets, list the extra ones too.

First thing we have to do is to know the minimum mask we need for 25 computers. To do this we need to use this formula $2^n - 2$, so $2^5 - 2 = 30$ hosts.

This is the general mask for class C 11111111.11111111.11111111.00000000

This is the subnet mask because we have to add 3 more bits of the last octet.

11111111.11111111.11111111.111**00000**
Hosts

255.255.255.224/27

1. 00000000 = 0
2. 00100000 = 32 -> This is the magic number because we add 32 to calculate the IP address of the different subnetworks.
3. 01000000 = 64
4. 01100000 = 96
5. 10000000 = 128
6. 10100000 = 160
7. 11000000 = 192
8. 11100000 = 224

Subnet	Network address	Host addresses	Broadcast address
Subnet mask: **255.255.255.224**			
First subnet	192.168.162.**0**	192.168.162.**1** – 192.168.162.**30**	192.168.162.**31**
Second subnet	192.168.162.**32**	192.168.162.**33** - 192.168.162.**62**	192.168.162.**63**
Third subnet	192.168.162.**64**	192.168.162.**65** - 192.168.162.**94**	192.168.162.**95**
Fourth subnet	192.168.162.**96**	192.168.162.**97** - 192.168.162.**126**	192.168.162.**127**
Firth subnet	192.168.162.**128**	192.168.162.**129** - 192.168.162.**158**	192.168.162.**159**
Sixth subnet	192.168.162.**160**	192.168.162.**161** - 192.168.162.**190**	192.168.162.**191**
Seventh subnet	192.168.162.**192**	192.168.162.**193** - 192.168.162.**222**	192.168.162.**223**
Eighth subnet	192.168.162.**224**	192.168.162.**225** - 192.168.162.**254**	192.168.162.**255**