

## Internetworking – Tutorial 3

### Subnetting and Supernetting

Remember:

#### IP Address Classes

Class A	1 – 127	(Network 127 is reserved for loopback and internal testing)		
		Leading bit pattern	0	00000000.00000000.00000000.00000000 Network . Host . Host . Host
Class B	128 – 191	Leading bit pattern	10	10000000.00000000.00000000.00000000 Network . Network . Host . Host
Class C	192 – 223	Leading bit pattern	110	11000000.00000000.00000000.00000000 Network . Network . Network . Host
Class D	224 – 239	(Reserved for multicast)		
Class E	240 – 255	(Reserved for experimental, used for research)		

#### Private Address Space

Class A	10.0.0.0 to 10.255.255.255
Class B	172.16.0.0 to 172.31.255.255
Class C	192.168.0.0 to 192.168.255.255

#### Default Subnet Masks

Class A	255.0.0.0
Class B	255.255.0.0
Class C	255.255.255.0

### Exercise 1-a:

Try to complete the following table based on the required specification:

Number of subnets in need: **6**

Number of usable hosts in need: **30**

Network address: **210.101.23.0**

<b>Address Class</b>	
<b>Default subnet mask</b>	
<b>Custom subnet mask</b>	
<b>Total number of subnets</b>	
<b>Total number of addresses per subnet</b>	
<b>Number of usable host addresses per subnet</b>	
<b>Number of bits borrowed for subnetting</b>	

### Exercise 1-b:

Try to complete the following table based on the required specification:

Number of subnets in need: **60**

Number of usable hosts in need: **1000**

Network address: **129.78.0.0**

<b>Address Class</b>	
<b>Default subnet mask</b>	
<b>Custom subnet mask</b>	
<b>Total number of subnets</b>	
<b>Total number of addresses per subnet</b>	
<b>Number of usable host addresses per subnet</b>	
<b>Number of bits borrowed for subnetting</b>	

### Exercise 1-c:

Try to complete the following table based on the required specification:

Number of subnets in need: **255**

Number of usable hosts in need: **21325**

Network address: **125.0.0.0**

<b>Address Class</b>	
<b>Default subnet mask</b>	
<b>Custom subnet mask</b>	
<b>Total number of subnets</b>	
<b>Total number of addresses per subnet</b>	
<b>Number of usable host addresses per subnet</b>	
<b>Number of bits borrowed for subnetting</b>	

### Exercise 1-d:

Try to complete the following table based on the required specification:

Number of subnets in need: **11**

Number of usable hosts in need: **18**

Network address: **202.199.0.0**

<b>Address Class</b>	
<b>Default subnet mask</b>	
<b>Custom subnet mask</b>	
<b>Total number of subnets</b>	
<b>Total number of addresses per subnet</b>	
<b>Number of usable host addresses per subnet</b>	
<b>Number of bits borrowed for subnetting</b>	

**Example:**

Try to complete the following table based on the required specification:

Number of subnets in need: **14**

Number of usable hosts in need: **14**

Network address: **192.10.10.0**

Address Class	C
Default subnet mask	255.255.255.0
Custom subnet mask	255.255.255.240
Total number of subnets	16
Total number of addresses per subnet	16
Number of usable host addresses per subnet	14
Number of bits borrowed for subnetting	4
What is the 4 <sup>th</sup> subnet range?	192.10.10.48 – 192.10.10.63
What is the subnet address for the 8 <sup>th</sup> subnet?	192.10.10.112
What is the broadcast address for the 13 <sup>th</sup> subnet?	192.10.10.207
What is the range of usable addresses for the 9 <sup>th</sup> subnet?	192.10.10.129 – 192.10.10.142

Number of Subnets	256	128	64	32	16	8	4	2	-	Number of Hosts
	2	4	8	16	32	64	128	256		
	128	64	32	16	8	4	2	1	-	Binary values
<u>192.10.10.0 0 0 0 0</u>										
(1)	0	0	0	0	192.10.10.0	to	192.10.10.15			
(2)	0	0	0	1	192.10.10.16	to	192.10.10.31			
(3)	0	0	1	0	192.10.10.32	to	192.10.10.47			
(4)	0	0	1	1	192.10.10.48	to	192.10.10.63			
(5)	0	1	0	0	192.10.10.64	to	192.10.10.79			
(6)	0	1	0	1	192.10.10.80	to	192.10.10.95			
(7)	0	1	1	0	192.10.10.96	to	192.10.10.111			
(8)	0	1	1	1	192.10.10.112	to	192.10.10.127			
(9)	1	0	0	0	192.10.10.128	to	192.10.10.143			
(10)	1	0	0	1	192.10.10.144	to	192.10.10.159			
(11)	1	0	1	0	192.10.10.160	to	192.10.10.175			
(12)	1	0	1	1	192.10.10.176	to	192.10.10.191			
(13)	1	1	0	0	192.10.10.192	to	192.10.10.207			
(14)	1	1	0	1	192.10.10.208	to	192.10.10.223			
(15)	1	1	1	0	192.10.10.224	to	192.10.10.239			
(16)	1	1	1	1	192.10.10.240	to	192.10.10.255			

$$\begin{array}{r}
 128 \\
 64 \\
 32 \\
 +16 \\
 \hline
 \text{Custom subnet mask } 240
 \end{array}$$

$$\begin{array}{r}
 16 \\
 -2 \\
 \hline
 \text{Usable hosts } 14
 \end{array}$$

Remember:

- The binary value of the last bit borrowed is the range. In this problem the range is 16.
- The first address in each subnet range is the subnet number.
- The last address in each subnet range is the subnet broadcast address.

## Exercise 2-a:

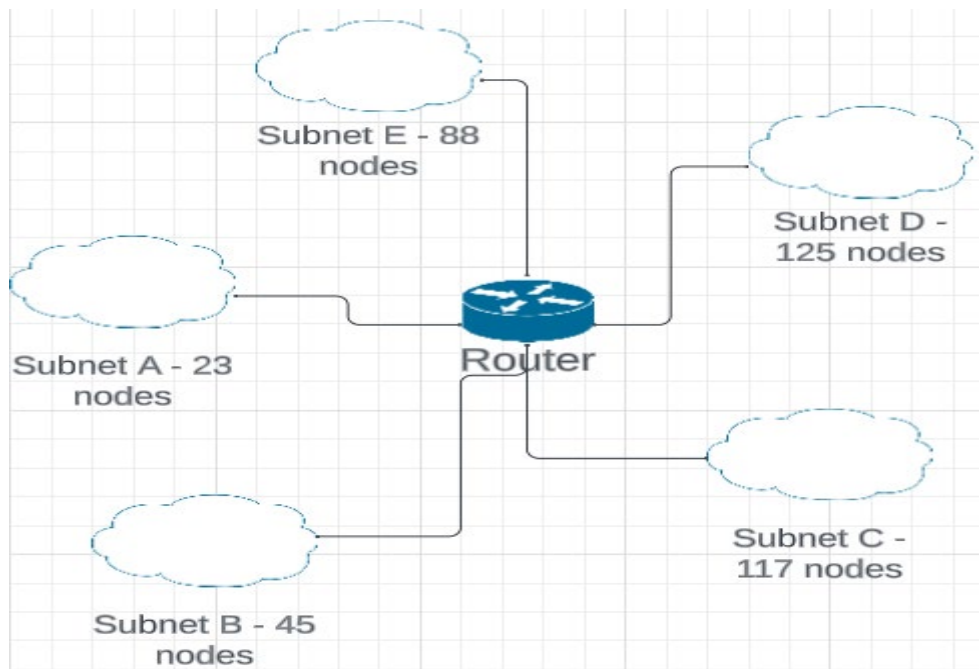
Try to complete the following table based on the required specification:

Number of subnets in need: **2**

Network address: **195.223.50.0**

You need to show how you worked out the solution!

<b>Address Class</b>	
<b>Default subnet mask</b>	
<b>Custom subnet mask</b>	
<b>Total number of subnets</b>	
<b>Total number of addresses per subnet</b>	
<b>Number of usable host addresses per subnet</b>	
<b>Number of bits borrowed for subnetting</b>	
<b>What is the 2<sup>nd</sup> subnet range?</b>	
<b>What is the subnet address for the 2<sup>nd</sup> subnet?</b>	
<b>What is the broadcast address for the 1<sup>st</sup> subnet?</b>	
<b>What is the first assignable address for the 1<sup>st</sup> subnet?</b>	

**Exercise 2-b:**

You are responsible to provide the IP addressing scheme for the above network. Firstly, choose the network address that meets your addressing needs from the two provided options below. Secondly, try to complete the following table.

(You are expected to follow the CLASSFULL IP addressing methodology)

Network address option #1: **190.212.0.0**

Network address option #2: **195.29.241.0**

You need to show how you worked out the solution!

<b>Preferred Network address</b>	
<b>Address Class</b>	
<b>Default subnet mask</b>	
<b>Custom subnet mask</b>	
<b>Total number of subnets</b>	
<b>Total number of addresses per subnet</b>	
<b>Number of usable host addresses per subnet</b>	
<b>Number of bits borrowed for subnetting</b>	
<b>What is the subnet address range for the Subnet B?</b>	
<b>What is the subnet address range for the Subnet D?</b>	

What is the subnet broadcast address for Subnet E?	
What is the first usable address for Subnet A?	
What is the last usable address for subnet A?	

**Hint: Work out the address ranges for subnets A to E**

## Exercise 2-c:

Try to complete the following table based on the required specification:

Number of usable hosts per subnet in need: **9763**

Network address: **133.97.0.0**

Address Class	
Default subnet mask	
Custom subnet mask	
Total number of subnets	
Total number of addresses per subnet	
Number of usable host addresses per subnet	
Number of bits borrowed for subnetting	
What is the subnet address range for the 2 <sup>nd</sup> subnet?	
What is the subnet address range for the 3 <sup>rd</sup> subnet?	
What is the subnet broadcast address for the 4 <sup>th</sup> subnet?	
What is the first usable address for the 1 <sup>st</sup> subnet?	
What is the last usable address for the 1 <sup>st</sup> subnet?	

**Hint: Work out the address ranges for the first five subnets**



## Supernetting

### Exercise 3-a:

Suppose an ISP maintains the following four Class B blocks:

- 151.12.0.0 /16
- 151.13.0.0 /16
- 151.14.0.0 /16
- 151.15.0.0 /16

What is the supernet address and supernet mask for the above networks?

(Hint: You might want to convert them into binary and calculate the common bits)

### Exercise 3-b:

Calculate the supernet address and mask for the following networks:

- 211.7.0.0 /24
- 211.7.1.0 /24
- 211.7.2.0 /24
- 211.7.3.0 /24

(Hint: You might want to convert them into binary and calculate the common bits)

### Exercise 3-c:

A company has been allocated the address range **187.11.0.0** to **187.27.255.255**

What is the network (supernet) address and what is the (supernet) mask?

(Hint: You might want to convert them into binary and calculate the common bits)

### Exercise 3-d:

A company has been allocated the network address **210.84.224.0 /22**.

Calculate the network (supernet) address and what are the first and last host addresses in the range? How many host addresses can be allocated (usable)?

(Hint: You might want to convert them into binary and calculate the common bits)