

Summary of Subnetting steps with tutorials:

1. Find the number of subnets:

2^x = number of subnets.

X: is the number of masked bits, the number of 1s, or the number after the slash notation.

For example:

11000000, here the number of ones is 2, and then according to the equation ($2^2=4$ is the number of subnets).

2. Find the number hosts:

$2^Y - 2$ = number of hosts per subnet.

Y is the number of unmasked bits, or the number of 0s

For example:

11000000

The number of 0s is 6 so: $2^6 - 2 = 62$ host per subnet

(Two of addresses are not valid: subnet address and the broadcast address).

3. Find the Block size of each subnet:

Block size = 256 - subnet mask

For: example:

$256 - 192 = 64$, so the block size of a 192 mask is always 64.

4. Find the range of valid hosts:

The valid hosts are the numbers of useable hosts in each subnet.

For example:

if the block size is 64 and the broadcast IP is (X.X.X.127) then 65-126 is the valid number of the host's range.

5. Broadcast address for each subnet:

The broadcast address is the last address of each subnet, or the address before the next subnet.

For example:

If we have the following subnets: 0, 64, 128, 192, and then the broadcast in each subnet is the number before the next subnet. Then the broadcast here is 63, 127, 191, and 255.

General Examples:

Q. Suppose that you have the following IP address and its subnet mask:

Find the no. of subnets, no. of valid hosts, block size, the subnets, and the broadcast

1. Network address (192.168.10.0)

Subnet mask is (255.255.255.128)

Number of subnets are :

Since the subnet mask is 128, this means that we borrowed 1 bit from the last octet 10000000.

$$2^x = 2^1 = 2 \text{ subnets}$$

Number of hosts:

The number of zeros in the last octet is 7, 10000000

$$\text{So } 2^y - 2 = 2^7 - 2 = 126.$$

126 is the number of hosts in each subnet.

The block size :

$$256 - 128 = 128 \text{ is the block size.}$$

The number of valid host for each subnet:

Subnet	0	128
First host	1	129
.....
Last host	126	254
Broadcast	127	255

The broadcast for each subnet is: 127 and 255.

2. 192.168.10.0/27

From this IP address, we conclude:

Network address 192.168.10.0

The subnet mask is 255.255.255.224

Number of subnets are :

Since the subnet mask is 224, this means that we borrow 3 bits from the last octet 11100000.

$$2^x = 2^3 = 8 \text{ subnets}$$

Number of hosts:

The number of zeros from the last octet is 5, 11100000

$$\text{So } 2^y - 2 = 2^5 - 2 = 30.$$

30 is the number of hosts in each subnet.

The block size :

$$256 - 224 = 32 \text{ is the block size.}$$

The hosts in each subnet:

Subnet	0	32	64	96	128	160	192	224
First host	1	33	65	97	129	161	193	225
.....
Last host	30	62	94	126	158	190	222	253
Broadcast	31	63	95	127	159	191	223	255

The broadcast in each subnet are:

31, 63, 95, 127, 159, 191, 223, and 255.

Class C - One Bit Subnetting Tutorial

Consider the network shown above. If we include one bit from the host part to the network part, the subnet mask is changed into 255.255.255.128. The single bit can have two values in last octet, either 0 or 1.

11000000.10101000.00001010.**0** | 0000000
 11111111.11111111.11111111.**1** | 0000000

That means, we can get two subnets if we do single bit subnetting.

Subnet no.	Description	Binaries	Decimal
1	Network Address	11000000.10101000.00001010.00000000	192.168.10.0
	First IPv4 address	11000000.10101000.00001010.00000001	192.168.10.1
	Last IPv4 address	11000000.10101000.00001010.01111110	192.168.10.126
	Broadcast Address	11000000.10101000.00001010.01111111	192.168.10.127
2	Network Address	11000000.10101000.00001010.10000000	192.168.10.128
	First IPv4 address	11000000.10101000.00001010.10000001	192.168.10.129
	Last IPv4 address	11000000.10101000.00001010.11111110	192.168.10.254
	Broadcast Address	11000000.10101000.00001010.11111111	192.168.10.255

The network 192.168.10.0 is divided into two networks, each network has 128 total IPv4 addresses and 126 usable IPv4 addresses (two IPv4 addresses are used in each subnet to represent the network address and the directed broadcast address). The subnet mask for one bit subnetting is 255.255.255.128.

Class C - Two Bit Subnetting Tutorial

If we include two bits from the host part to the network part, the subnet mask is changed into 255.255.255.192. The two bits added to network part can have four possible values in last octet and that are 00, 01, 10 and 11. That means, we can get four networks if we do two bit subnetting.

11000000.10101000.00001010.**00** | 000000
 11111111.11111111.11111111.**11** | 000000

Subnet no.	Description	Binaries	Decimal
1	Network Address	11000000.10101000.00001010.00000000	192.168.10.0
	First IPv4 address	11000000.10101000.00001010.00000001	192.168.10.1
	Last IPv4 address	11000000.10101000.00001010.00111110	192.168.10.62
	Broadcast Address	11000000.10101000.00001010.00111111	192.168.10.63
2	Network Address	11000000.10101000.00001010.01000000	192.168.10.64
	First IPv4 address	11000000.10101000.00001010.01000001	192.168.10.65
	Last IPv4 address	11000000.10101000.00001010.01111110	192.168.10.126
	Broadcast Address	11000000.10101000.00001010.01111111	192.168.10.127

3	Network Address	11000000.10101000.00001010.10000000	192.168.10.128
	First IPv4 address	11000000.10101000.00001010.10000001	192.168.10.129
	Last IPv4 address	11000000.10101000.00001010.10111110	192.168.10.190
	Broadcast Address	11000000.10101000.00001010.10111111	192.168.10.191
4	Network Address	11000000.10101000.00001010.11000000	192.168.10.192
	First IPv4 address	11000000.10101000.00001010.11000001	192.168.10.193
	Last IPv4 address	11000000.10101000.00001010.11111110	192.168.10.254
	Broadcast Address	11000000.10101000.00001010.11111111	192.168.10.255

The network 192.168.10.0 is divided into four networks, each network has 64 total IPv4 addresses and 62 usable IPv4 addresses (two IPv4 addresses are used in each subnet to represent the network address and the directed broadcast address). The subnet mask for two bit subnetting is 255.255.255.192.

Class C - 3 Bit Subnetting Tutorial

If we include three bits from the host part to the network part, the subnet mask is changed into 255.255.255.224. The three bits added to network part can have eight possible values in last octet and that are 000, 001, 010, 011, 100, 101, 110 and 111. That means, we can get eight networks if we do a three bit subnetting.

11000000.10101000.00001010.**000** | 00000
 11111111.11111111.11111111.**111** | 00000

Subnet no.	Description	Binaries	Decimal
1	Network Address	11000000.10101000.00001010.00000000	192.168.10.0
	First IPv4 address	11000000.10101000.00001010.00000001	192.168.10.1
	Last IPv4 address	11000000.10101000.00001010.00011110	192.168.10.30
	Broadcast Address	11000000.10101000.00001010.00011111	192.168.10.31
2	Network Address	11000000.10101000.00001010.00100000	192.168.10.32
	First IPv4 address	11000000.10101000.00001010.00100001	192.168.10.33
	Last IPv4 address	11000000.10101000.00001010.00111110	192.168.10.62
	Broadcast Address	11000000.10101000.00001010.00111111	192.168.10.63
3	Network Address	11000000.10101000.00001010.01000000	192.168.10.64
	First IPv4 address	11000000.10101000.00001010.01000001	192.168.10.65
	Last IPv4 address	11000000.10101000.00001010.01011110	192.168.10.94
	Broadcast Address	11000000.10101000.00001010.01011111	192.168.10.95
4	Network Address	11000000.10101000.00001010.01100000	192.168.10.96
	First IPv4 address	11000000.10101000.00001010.01100001	192.168.10.97
	Last IPv4 address	11000000.10101000.00001010.01111110	192.168.10.126
	Broadcast Address	11000000.10101000.00001010.01111111	192.168.10.127
5	Network Address	11000000.10101000.00001010.10000000	192.168.10.128
	First IPv4 address	11000000.10101000.00001010.10000001	192.168.10.129
	Last IPv4 address	11000000.10101000.00001010.10011110	192.168.10.158
	Broadcast Address	11000000.10101000.00001010.10011111	192.168.10.159

6	Network Address	11000000.10101000.00001010.10100000	192.168.10.160
	First IPv4 address	11000000.10101000.00001010.10100001	192.168.10.161
	Last IPv4 address	11000000.10101000.00001010.10111110	192.168.10.190
	Broadcast Address	11000000.10101000.00001010.10111111	192.168.10.191
7	Network Address	11000000.10101000.00001010.11000000	192.168.10.192
	First IPv4 address	11000000.10101000.00001010.11000001	192.168.10.193
	Last IPv4 address	11000000.10101000.00001010.11011110	192.168.10.222
	Broadcast Address	11000000.10101000.00001010.11011111	192.168.10.223
8	Network Address	11000000.10101000.00001010.11100000	192.168.10.224
	First IPv4 address	11000000.10101000.00001010.11100001	192.168.10.225
	Last IPv4 address	11000000.10101000.00001010.11111110	192.168.10.254
	Broadcast Address	11000000.10101000.00001010.11111111	192.168.10.255

The network 192.168.10.0 is divided into eight networks, each network has 32 total IPv4 addresses and 30 usable IPv4 addresses (two IPv4 addresses are used in each subnet to represent the network address and the directed broadcast address). The subnet mask for three bit subnetting is 255.255.255.224.

Class C Subnetting can be summarized as below.

Subnet Bits	Subnet Mask	CIDR	Total Subnets	Usable IPs/Subnet
0	255.255.255.0	/24	1	254
1	255.255.255.128	/25	2	126
2	255.255.255.192	/26	4	62
3	255.255.255.224	/27	8	30
4	255.255.255.240	/28	16	14
5	255.255.255.248	/29	32	6
6	255.255.255.252	/30	64	2

Class B Subnetting

Remember, the first two octets of a Class B network is used to represent the network and the last two octets are used to represent the host. The default format for a Class B IPv4 address is (Network.Network.Host.Host).

Let us consider an example of Class B network 172.16.0.0 - 255.255.0.0. The binary representation of the above network and subnet mask (SN) is:

Component	Binary	Decimal
Address Part	10101100.00010000.00000000.00000000	172.16.0.0
SN Mask	11111111.11111111.00000000.00000000	255.255.0.0

- If all the bits in the host part are "0", that represents the **network id**.
- If all the bits in the host part are "0" except the last bit, it is the **first usable IPv4 address**.
- If all the bits in the host part are "1" except the last bit, it is the **last usable IPv4 address**.
- If all the bits in the host part are "1", that represents the **directed broadcast address**.

All the IPv4 addresses between the first and last IPv4 addresses (including the first and last) can be used to configure the devices.

Class B - One Bit Subnetting

If we include one bit from the host part to the network part, the subnet mask is changed into 255.255.128.0. The single bit can have two values in third octet, either 0 or 1.

10101100.00010000.**0** | 00000000.00000000
 11111111.11111111.**1** | 00000000.00000000

That means, we can get two subnets if we do single bit subnetting.

SN No.	Description	Binaries	Decimal
1	Network Address	10101100.00010000.00000000.00000000	172.16.0.0
	First IPv4 address	10101100.00010000.00000000.00000001	172.16.0.1
	Last IPv4 address	10101100.00010000.01111111.11111110	172.16.127.254
	Broadcast Address	10101100.00010000.01111111.11111111	172.16.127.255
2	Network Address	10101100.00010000.10000000.00000000	172.16.128.0
	First IPv4 address	10101100.00010000.10000000.00000001	172.16.128.1
	Last IPv4 address	10101100.00010000.11111111.11111110	172.16.255.254
	Broadcast Address	10101100.00010000.11111111.11111111	172.16.255.255

The network 172.16.0.0 is divided into two networks, each network has 32768 total IPv4 addresses and 32766 usable IPv4 addresses (two IPv4 addresses are used in each subnet to represent the network address and the directed broadcast address). The subnet mask for one bit subnetting is 255.255.128.0.

Class B - Two Bit Subnetting

If we include two bits from the host part to the network part, the subnet mask is changed into 255.255.192.0. The two bits added to network part can have four possible values in third octet, 00, 01, 10, and 11.

10101100.00010000.**00** | 000000.00000000
 11111111.11111111.**11** | 000000.00000000

That means, we can get four networks if we do a two bit subnetting.

SN No.	Description	Binaries	Decimal
1	Network Address	10101100.00010000.00000000.00000000	172.16.0.0
	First IPv4 address	10101100.00010000.00000000.00000001	172.16.0.1
	Last IPv4 address	10101100.00010000.00111111.11111110	172.16.63.254
	Broadcast Address	10101100.00010000.00111111.11111111	172.16.63.255

2	Network Address	10101100.00010000.01000000.00000000	172.16.64.0
	First IPv4 address	10101100.00010000.01000000.00000001	172.16.64.1
	Last IPv4 address	10101100.00010000.01111111.11111110	172.16.127.254
	Broadcast Address	10101100.00010000.01111111.11111111	172.16.127.255
3	Network Address	10101100.00010000.10000000.00000000	172.16.128.0
	First IPv4 address	10101100.00010000.10000000.00000001	172.16.128.1
	Last IPv4 address	10101100.00010000.10111111.11111110	172.16.191.254
	Broadcast Address	10101100.00010000.10111111.11111111	172.16.191.255
4	Network Address	10101100.00010000.11000000.00000000	172.16.192.0
	First IPv4 address	10101100.00010000.11000000.00000001	172.16.192.1
	Last IPv4 address	10101100.00010000.11111111.11111110	172.16.255.254
	Broadcast Address	10101100.00010000.11111111.11111111	172.16.255.255

The network 172.16.0.0 is divided into four networks, each network has 16384 total IPv4 addresses and 16382 usable IPv4 addresses (two IPv4 addresses are used in each subnet to represent the network address and the directed broadcast address). The subnet mask for one bit subnetting is 255.255.192.0.

Class B - 3 Bit Subnetting

If we include three bits from the host part to the network part, the subnet mask is changed into 255.255.224.0 .The three bits added to network part can have eight possible values in the third octet and that are 000, 001, 010, and 011, 100, 101, 110 and 111.

10101100.00010000.**000** | 00000.00000000
 11111111.11111111.**111** | 00000.00000000

That means, we can get eight networks if we do three bit subnetting.

SN No	Description	Binaries	Decimal
1	Network Address	10101100.00010000.00000000.00000000	172.16.0.0
	First IPv4 address	10101100.00010000.00000000.00000001	172.16.0.1
	Last IPv4 address	10101100.00010000.00011111.11111110	172.16.31.254
	Broadcast Address	10101100.00010000.00011111.11111111	172.16.31.255
2	Network Address	10101100.00010000.00100000.00000000	172.16.32.0
	First IPv4 address	10101100.00010000.00100000.00000001	172.16.32.1
	Last IPv4 address	10101100.00010000.00111111.11111110	172.16.63.254
	Broadcast Address	10101100.00010000.00111111.11111111	172.16.63.255
3	Network Address	10101100.00010000.01000000.00000000	172.16.64.0
	First IPv4 address	10101100.00010000.01000000.00000001	172.16.64.1
	Last IPv4 address	10101100.00010000.01011111.11111110	172.16.95.254
	Broadcast Address	10101100.00010000.01011111.11111111	172.16.95.255
4	Network Address	10101100.00010000.01100000.00000000	172.16.96.0
	First IPv4 address	10101100.00010000.01100000.00000001	172.16.96.1
	Last IPv4 address	10101100.00010000.01111111.11111110	172.16.127.254
	Broadcast Address	10101100.00010000.01111111.11111111	172.16.127.255

5	Network Address	10101100.00010000.10000000.00000000	172.16.128.0
	First IPv4 address	10101100.00010000.10000000.00000001	172.16.128.1
	Last IPv4 address	10101100.00010000.10011111.11111110	172.16.159.254
	Broadcast Address	10101100.00010000.10011111.11111111	172.16.159.255
6	Network Address	10101100.00010000.10100000.00000000	172.16.160.0
	First IPv4 address	10101100.00010000.10100000.00000001	172.16.160.1
	Last IPv4 address	10101100.00010000.10111111.11111110	172.16.191.254
	Broadcast Address	10101100.00010000.10111111.11111111	172.16.191.255
7	Network Address	10101100.00010000.11000000.00000000	172.16.192.0
	First IPv4 address	10101100.00010000.11000000.00000001	172.16.192.1
	Last IPv4 address	10101100.00010000.11011111.11111110	172.16.223.254
	Broadcast Address	10101100.00010000.11011111.11111111	172.16.223.255
8	Network Address	10101100.00010000.11100000.00000000	172.16.224.0
	First IPv4 address	10101100.00010000.11100000.00000001	172.16.224.1
	Last IPv4 address	10101100.00010000.11111111.11111110	172.16.255.254
	Broadcast Address	10101100.00010000.11111111.11111111	172.16.255.255

The network 172.16.0.0 is divided into eight networks, each network has 8192 total IPv4 addresses and 8190 usable IPv4 addresses (two IPv4 addresses are used in each subnet to represent the network address and the directed broadcast address).

Class B Subnetting can be summarized as below.

Subnet Bits	Subnet Mask	CIDR	Total Subnets	Usable IP Address/Subnet
0	255.255.0.0	/16	1	65534
1	255.255.128.0	/17	2	32766
2	255.255.192.0	/18	4	16382
3	255.255.224.0	/18	8	8190
4	255.255.240.0	/20	16	4094
5	255.255.248.0	/21	32	2046
6	255.255.252.0	/22	64	1022
7	255.255.254.0	/23	128	510
8	255.255.255.0	/24	256	254
9	255.255.255.128	/25	512	126
10	255.255.255.192	/26	1024	62
11	255.255.255.224	/27	2048	30
12	255.255.255.240	/28	4096	14
13	255.255.255.248	/29	8192	6
14	255.255.255.252	/30	16384	2

Class A Subnetting

Remember, the first octet of a Class A network is used to represent the network and the remaining three octets are used to represent the host. The default format for a Class A IPv4 address is (Network.Host.Host.Host).

Let us consider an example of Class A network 10.0.0.0 - 255.0.0.0. The binary representation of the above network and subnet mask is

Component	Binary	Decimal
Address Part	00001010.00000000.00000000.00000000	10.0.0.0
Subnet Mask	11111111.00000000.00000000.00000000	255.0.0.0

Once again,

- If all the bits in the host part are "0", that represents the **network address**.
- If all the bits in the host part are "0" except the last bit, it is the **first usable IPv4 address**.
- If all the bits in the host part are "1" except the last bit, it is the **last usable IPv4 address**.
- If all the bits in the host part are "1", that represents the **direct broadcast address**.

All the IPv4 addresses between the first and last IPv4 addresses (including the first and last) can be used to configure the devices.

Class A - One Bit Subnetting

If we include one bit from the host part to the network part, the subnet mask is changed into 255.255.128.0. The single bit can have two values in second octet, either 0 or 1.

00001010.**0** | 00000000.00000000.00000000
 11111111.**1** | 00000000.00000000.00000000

That means, we can get two subnets if we do single bit subnetting. The subnet mask for one bit subnetting is 255.128.0.0.

SN No	Description	Binaries	Decimal
1	Network Address	00001010.00000000.00000000.00000000	10.0.0.0
	First IPv4 address	00001010.00000000.00000000.00000001	10.0.0.1
	Last IPv4 address	00001010.01111111.11111111.11111110	10.127.255.254
	Broadcast Address	100001010.01111111.11111111.11111110	10.127.255.255
2	Network Address	00001010.10000000.00000000.00000000	10.128.0.0
	First IPv4 address	00001010.10000000.00000000.00000001	10.128.0.1
	Last IPv4 address	00001010.11111111.11111111.11111110	10.255.255.254
	Broadcast Address	00001010.11111111.11111111.11111111	10.255.255.255

The network 10.0.0.0 is divided into two networks, each network has 8388608 total IPv4 Addresses and 8388606 usable IPv4 Addresses (two IPv4 Addresses are used in each subnet to represent the network address and the directed broadcast address).

Class A - Two Bit Subnetting

If we include two bits from the host part to the network part, the subnet mask is changed into 255.192.0.0. The two bits added to network part can have four possible values in second octet, 00, 01, 10, and 11.

00001010.**00** | 000000.00000000.00000000
 11111111.**11** | 000000.00000000.00000000

That means, we can get four networks if we do a two bit subnetting. The subnet mask for two bit subnetting is 255.192.0.0.

SN No.	Description	Binaries	Decimal
1	Network Address	00001010.00000000.00000000.00000000	10.0.0.0
	First IPv4 address	00001010.00000000.00000000.00000001	10.0.0.1
	Last IPv4 address	00001010.00111111.11111111.11111110	10.63.255.254
	Broadcast Address	00001010.00111111.11111111.11111111	10.63.255.255
2	Network Address	00001010.01000000.00000000.00000000	10.64.0.0
	First IPv4 address	00001010.01000000.00000000.00000001	10.64.0.1
	Last IPv4 address	00001010.01111111.11111111.11111110	10.127.255.254
	Broadcast Address	00001010.01111111.11111111.11111111	10.127.255.255
3	Network Address	00001010.10000000.00000000.00000000	10.128.0.0
	First IPv4 address	00001010.10000000.00000000.00000001	10.128.0.1
	Last IPv4 address	00001010.10111111.11111111.11111110	10.191.255.254
	Broadcast Address	00001010.10111111.11111111.11111111	10.191.255.255
4	Network Address	00001010.11000000.00000000.00000000	10.192.0.0
	First IPv4 address	00001010.11000000.00000000.00000001	10.192.0.1
	Last IPv4 address	00001010.11111111.11111111.11111110	10.255.255.254
	Broadcast Address	00001010.11111111.11111111.11111111	10.255.255.255

The network 10.0.0.0 is divided into four networks, each network has 4194304 total IPv4 Addresses and 4194302 usable IPv4 Addresses (two IPv4 Addresses are used in each subnet to represent the network address and the directed broadcast address).

Class A - 3 Bit Subnetting

If we include three bits from the host part to the network part, the subnet mask is changed into 255.224.0.0 the three bits added to network part can have eight possible values in the second octet and that are 000, 001, 010, and 011, 100, 101, 110 and 111.

00001010.**000** | 00000.00000000.00000000
 11111111.**111** | 00000.00000000.00000000

That means, we can get eight networks if we do three bit subnetting and the subnet mask will be 255.224.0.0.

SN No.	Description	Binaries	Decimal
1	Network Address	00001010.00000000.00000000.00000000	10.0.0.0
	First IPv4 address	00001010.00000000.00000000.00000001	10.0.0.1
	Last IPv4 address	00001010.00011111.11111111.11111110	10.31.255.254
	Broadcast Address	00001010.00011111.11111111.11111111	10.31.255.255
2	Network Address	00001010.00100000.00000000.00000000	10.32.0.0
	First IPv4 address	00001010.00100000.00000000.00000001	10.32.0.1
	Last IPv4 address	00001010.00111111.11111111.11111110	10.63.255.254
	Broadcast Address	00001010.00111111.11111111.11111111	10.63.255.255
3	Network Address	00001010.01000000.00000000.00000000	10.64.0.0
	First IPv4 address	00001010.01000000.00000000.00000001	10.64.0.1
	Last IPv4 address	00001010.01011111.11111111.11111110	10.95.255.254
	Broadcast Address	00001010.01011111.11111111.11111111	10.95.255.255
4	Network Address	00001010.01100000.00000000.00000000	10.96.0.0
	First IPv4 address	00001010.01100000.00000000.00000001	10.96.0.1
	Last IPv4 address	00001010.01111111.11111111.11111110	10.127.255.254
	Broadcast Address	00001010.01111111.11111111.11111111	10.127.255.255
5	Network Address	00001010.10000000.00000000.00000000	10.128.0.0
	First IPv4 address	00001010.10000000.00000000.00000001	10.128.0.1
	Last IPv4 address	00001010.10011111.11111111.11111110	10.159.255.254
	Broadcast Address	00001010.10011111.11111111.11111111	10.159.255.255
6	Network Address	00001010.10100000.00000000.00000000	10.160.0.0
	First IPv4 address	00001010.10100000.00000000.00000001	10.160.0.1
	Last IPv4 address	00001010.10111111.11111111.11111110	10.191.255.254
	Broadcast Address	00001010.10111111.11111111.11111111	10.191.255.255
7	Network Address	00001010.11000000.00000000.00000000	10.192.0.0
	First IPv4 address	00001010.11000000.00000000.00000001	10.192.0.1
	Last IPv4 address	00001010.11011111.11111111.11111110	10.223.255.254
	Broadcast Address	00001010.11011111.11111111.11111111	10.223.255.255
8	Network Address	00001010.11100000.00000000.00000000	10.224.0.0
	First IPv4 address	00001010.11100000.00000000.00000001	10.224.0.1
	Last IPv4 address	00001010.11111111.11111111.11111110	10.255.255.254
	Broadcast Address	00001010.11111111.11111111.11111111	10.255.255.255

The network 10.0.0.0 is divided into eight networks, each network has 2097152 total IPv4 Addresses and 2097150 usable IPv4 Addresses (two IPv4 Addresses are used in each subnet to represent the network address and the directed broadcast address).

Class A IPv4 Subnetting can be summarized as below.

Subnet Bits	Subnet Mask	CIDR	Total Subnets	Usable IP Address/Subnet
0	255.0.0.0	/8	1	16777214
1	255.128.0.0	/9	2	8388606
2	255.192.0.0	/10	4	4194302

3	255.224.0.0	/11	8	2097150
4	255.240.0.0	/12	16	1048574
5	255.248.0.0	/13	32	524286
6	255.252.0.0	/14	64	262142
7	255.254.0.0	/15	128	131070
8	255.255.0.0	/16	256	65534
9	255.255.128.0	/17	512	32766
10	255.255.192.0	/18	1024	16382
11	255.255.224.0	/19	2048	8190
12	255.255.240.0	/20	4096	4094
13	255.255.248.0	/21	8192	2046
14	255.255.252.0	/22	16384	1022
15	255.255.254.0	/23	32768	510
16	255.255.255.0	/24	65536	254
17	255.255.255.128	/25	131072	126
18	255.255.255.192	/26	262144	62
19	255.255.255.224	/27	524288	30
20	255.255.255.240	/28	1048576	14
21	255.255.255.248	/29	2097152	6
22	255.255.255.252	/30	4194304	2

Homework:

First:

- What is the broadcast address of the network 10.7.176.0 255.255.240.0?
- What valid host range is the IP address 192.168.23.153/30 a part of?
- You need to assign a server the last valid host address on the subnet 172.19.144.0/20. What IP address would you assign?
- What is the broadcast address of the network 192.168.40.48/29?
- How many subnets and hosts per subnet can you get from the network 172.31.0.0/19?
- You have a point-to-point connection that needs exactly two usable host addresses. What subnet mask should you use?
- Which subnet does host 172.16.41.187/20 belong to?
- Network 172.31.0.0 needs to be subnetted into 67 different networks. Each subnet needs a minimum of 300 host addresses. What subnet mask would you use?
- You need to assign a server the last valid host address of the fourth subnet on network 192.168.24.0/28. What address would you use?
- You are given IP address 172.21.45.143/22. What is the first valid host address on this subnet?

Second:

Find the number of subnets, broadcast address, block size, and valid host range:

- 192.168.100.25/30
- 192.168.100.37/28

3. 192.168.100.66/27
4. 192.168.100.17/29
5. 192.168.100.99/26
6. 192.168.100.99/25
7. 172.16.100.0/20
8. 172.16.105.0/21
9. 172.16.99.0/19
- 10.172.16.30.0/18
- 11.172.16.70.0/22
- 12.172.16.60.0/23