Subnetting

Subnetting is all about breaking down large network. To understand this further, we need to understand the two types of IP addresses.

Private IP Address

These are addresses in the range

Class A: 10.0.0.0 — 10.255.255.255
16,777,216 IP addresses

Class B: 172.16.0.0 - 172.31.255.255
1,048,576 IP addresses

Class C: 192.168.0.0 - 192.168.255.255
65,536 IP addresses

- These addresses can't go on the internet (can only travel in LAN)

Example 1:

Class C

IP address: 192.168.100.225

Subnet mask: 255.255.255.000 (Default Subnet mask for class C)

Network ID: 192.168.100.0

Broadcast ID: 192.168.100.255

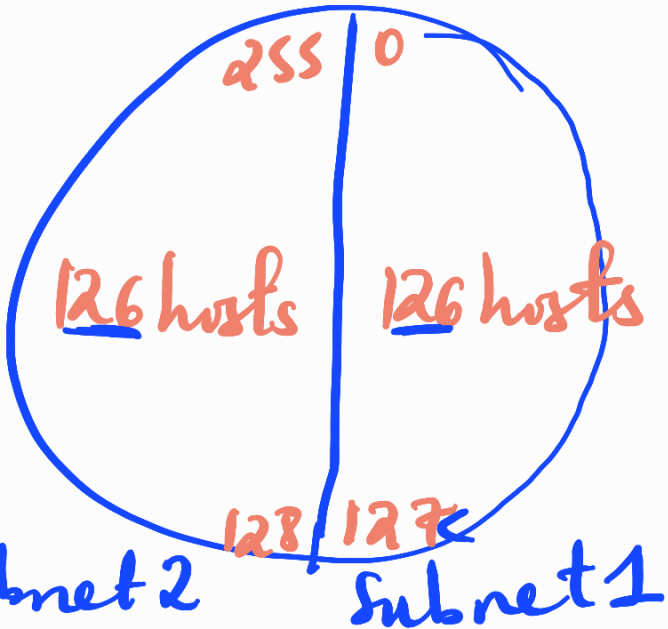
} 254 hosts, 1 network

Once we are subnetting, we go into Classless Inter Domain Routing (CIDR)

To break a network into 2, we borrow 1 bit as shown below

11111111.11111111.11111111.1 | 0000000

network | host



$0-(2^7-2)$ hosts

1	6	3	1	8	4	2	1
128	64	32	16				
1	1	1					

Network ID1: 192.168.100.0/25

Broadcast ID1: 192.168.100.127/25

Network ID2: 192.168.100.128/25

Broadcast ID2: 192.168.100.255/25

Example 2

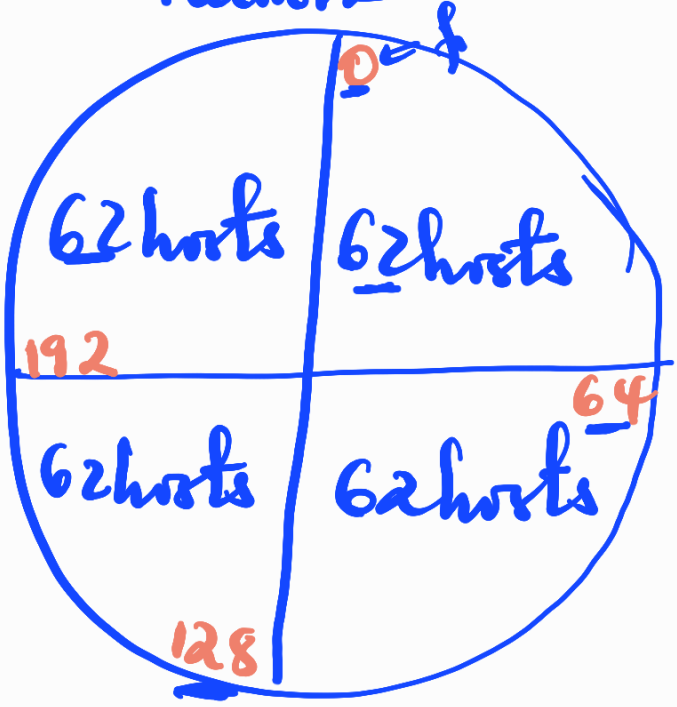
IP Address 192.168.100.225

Subnet Mask 255.255.255.192 /26

clarders

11111111.11111111.11111111.11000000

network | hosts



2^2 subnets = 4 subnets

(2^6-2) hosts

128	64	32	16	8	4	2	1
1	1	1	0	0	0	0	0

255.255.255.11000000

192.168.100.0/24

Network 101 192.168.100.0 /26

Broadcast 101 192.168.100.63 /26

Network 102 192.168.100.64 /26

Broadcast 102 192.168.100.127 /26

Network 103 192.168.100.128 /26

Broadcast 103 192.168.100.191 /26

Network 104 192.168.100.192 /26

Broadcast 104 192.168.100.255 /26

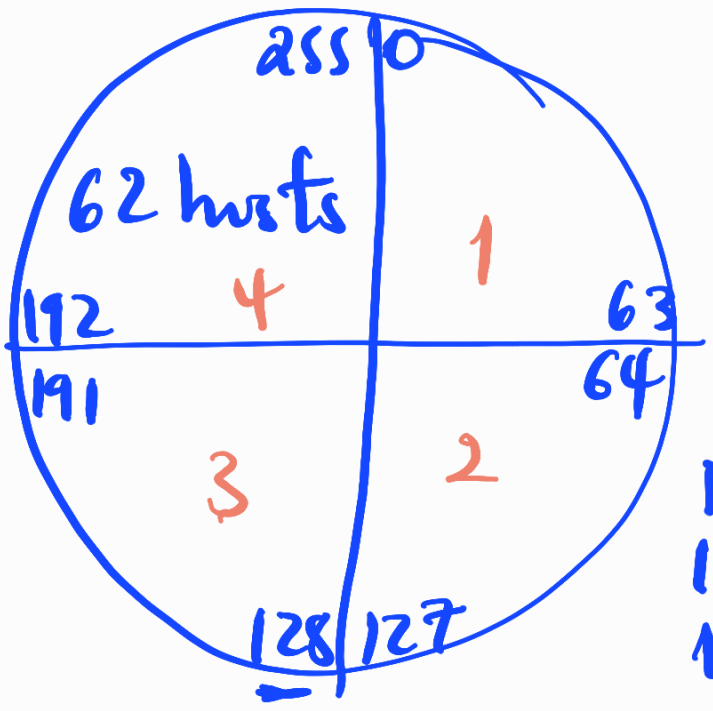
Borrowed bits	1	2	3	4	5	6
Mask value	128	192	224	240	248	252
Subnet	$2 2^1$	$4 2^2$	$8 2^3$	$16 2^4$	$32 2^5$	$64 2^6$
Hosts	126	62	30	14	6	2
CIDR	/25	/26	/27	/28	/29	/30
Block Size	128	64	32	16	8	4

Exercise: 1) Create 3 sub-networks

2) Use a Class C IP address 192.168.1.0

3) Determine the network Id and Broadcast Id of all the subnets

Soln



Network ID1:

192.168.1.0/26

192.168.1.63/26 Bro

Network ID2:

192.168.1.64/26

192.168.1.127/26

Network ID3

192.168.1.128/26

192.168.1.191/26

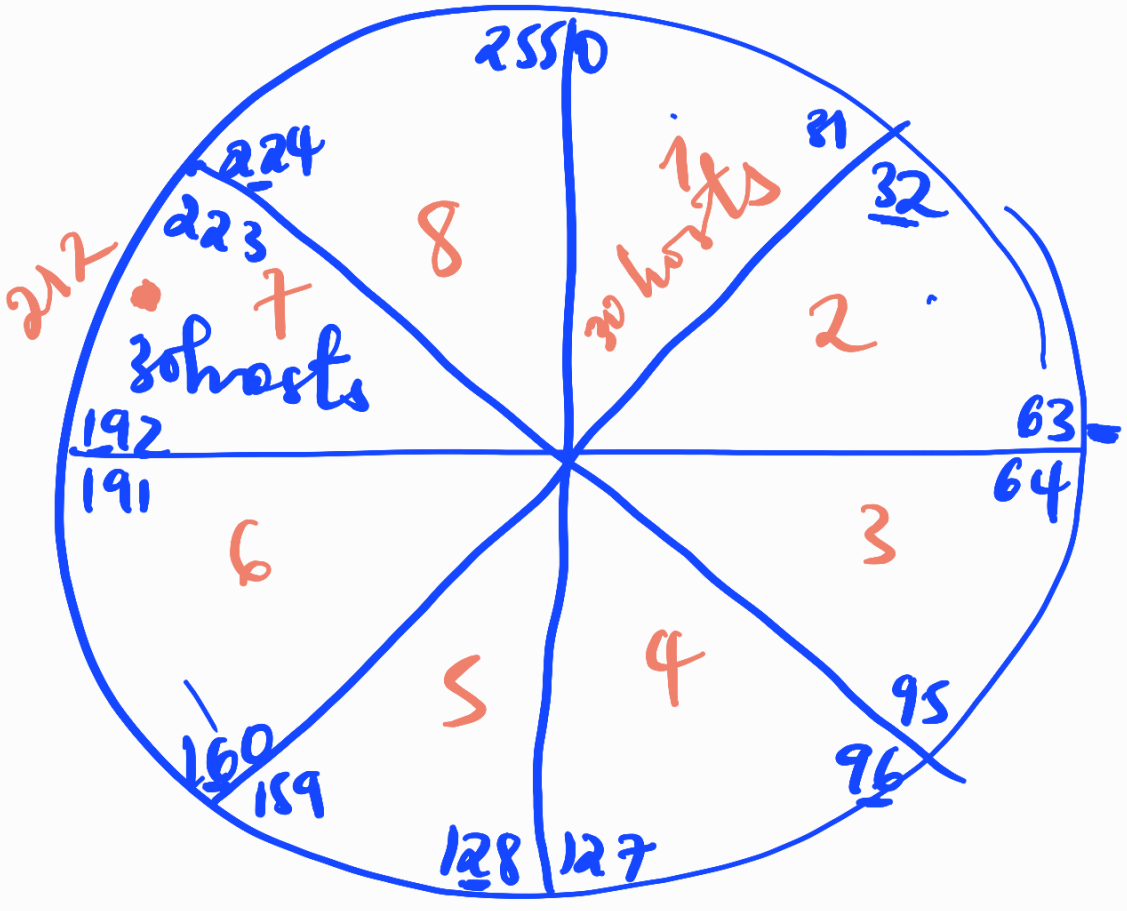
Exercise2: Find the Network ID and Broadcast ID of this IP addrers

192.168.225.212 /27

2^{4+3}

2^3 subnets

Subnet mask: 255.255.255.224



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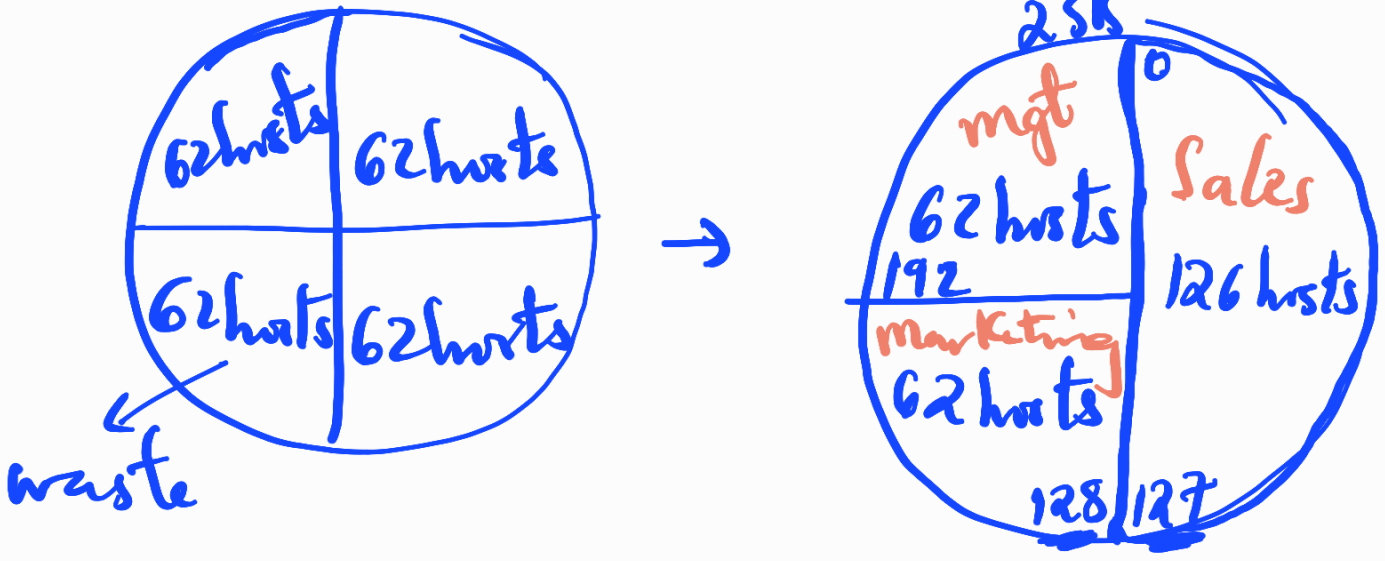
Network ID: 192.168.225.192/27

Broadcast ID: 192.168.225.223/27

VLSM (Variable Length Subnet Mask)

Requirements: 192.168.1.212/24

1) Design a network with 3 Networks: Marketing, Sales, Management
2) Marketing require 60 computers; sales requires 100 computers and management requires 34 computers.



Sales:

Network ID: 192.168.1.0/25 (1 bit borrowed)

Broadcast ID: 192.168.1.127/25

128	64	32	16	8	4	2	1	← place value
1	1	1	1	1	1	1	1	
0	1	0	0	0	0	0	0	

Marketing:

Network ID: 192.168.1.128/26

Broadcast ID: 192.168.1.191/26

Management:

Network ID: 192.168.1.192/26

Broadcast ID: 192.168.1.255/26

Class B Subnetting

Example: IP address: 172.16.100.22

Subnet Mask: 255.255.0.0

Let's break it into 2 subnets (so we borrow one bit)

Network ID1 172.16.0.0/17

Broadcast ID1 172.16.127.255/17

Network ID2 172.16.128.0/17

Broadcast ID2 172.16.255.255/17

Exercise: IP Address 172.16.100.255
Subnet Mask 255.255.0.0
Break this into 4 subnets?

172.16.0.0 /18
172.16.63.255/18

172.16.64.0 /18
172.16.127.255/18

172.16.128.0 /18
172.16.191.255/18

172.16.192.0 /18
172.16.255.255/18

ID1	ID2	ID3
10.0.0.0	10.64.0.0	10.128.0.0
10.63.285.255	10.127.255.255	10.191.255.255

Class A Subnetting

10.192.0.0
10.255.255.255

Example: IP Address 10.20.100.225
Subnet Mask 255.0.0.0 (Default)
Break into 2 subnets (So we borrow one bit)
n° of hosts = $(2^{23}-2)$ hosts 128
Network ID1 10.0.0.0 /9
Broadcast ID1 10.127.255.255/9
Network ID2 10.128.0.0 /9
Broadcast ID2 10.255.255.255/9

Exercise: IP address 10.20.100.225
Subnet mask 255.0.0.0
Break this into 4 subnets?

CA: Find the network and broadcast ID of (a) 172.10.21.21/24
(b) 10.210.170.255/23

Done

ID1:
10.0.0.0/10
10.63.255.255

ID2
10.64.0.0/10
10.127.255.255

ID3
10.128.0.0/10
10.191.255.255

Supernetting

→ You take smaller networks and combine it to one (opposite of subnetting)

Example 1: Let's consider the Class C subnetting example2 we did earlier (Pg 3 and 4)

192.168.100.0/24

Example2: Summarize these 6 IP addresses below into 1 IP address

172.168.197.0 /24
172.168.198.0 /24
172.168.199.0 /24
172.168.200.0/24
172.168.204.0/24
172.168.206.0/24

Soln: Convert into binary and observe the changes

1 + 8 + 4 128+64=192

172.168.1100 0101.0 /24

172.168.1100 0110.0 /24

172.168.1100 0111.0 /24

172.168.1100 1000.0 /24

172.168.1100 1100.0 /24

172.168.1100 1110.0 /24

Make everything beyond the red line as zero. So we have

172.168.11000000.0 which gives

172.168.192.0 /20

CA3: Find the network and broadcast ID of

1) 20.120.47.225/13

2) 220.20.17.5/27

3) 10.10.7.17/19

4) 192.8.3.1/18

5) 172.1.4.5/20

255

255.255.11111111.00000000

Soln

CA(a): 172.10.21.21/24

Class B → /16

This means 8 bits have been borrowed

Subnet Mask: 255.255.255.000

2^8 Subnets, place value = 1

Network ID1 172.10.0.0

Broadcast ID1 172.10.0.255

Network ID2: 172.10.1.0

Broadcast ID2: 172.10.1.255

⋮

Network ID : 172.10.21.0

Broadcast ID : 172.10.21.255

(b) Find the network and broadcast ID of 10.210.170.255/23

Class A → /8

This means 15 bits have been borrowed.

2^{15} Subnets, place value = 2

Recall:

Borrowed bits	1	2	3	4	5	6	7	8
Mask value	128	192	224	240	248	252	254	255
Place value	128	64	32	16	8	4	2	1

Network ID1: 10.0.0.0

Broadcast ID1: 10.0.1.255

Network ID2: 10.0.2.0

Broadcast ID2: 10.0.3.255

⋮

Network ID: 10.0.254.0

Broadcast ID: 10.0.255.255

Network ID: 10.1.0.0

Broadcast ID: 10.1.1.255

⋮

Network ID: 10.210.0.0

Broadcast ID: 10.210.1.255

⋮

Network ID: 10.210.170.0

Broadcast ID: 10.210.171.255

Observations

1) When the last octet is 255, it does not always mean broadcast ID. We need to always calculate it.

2) Always count the subnet mask value to see which octet we are working in (we are working on the third octet instead of the second octet)