

# IP Address in Networking

## Classless Inter Domain Routing (CIDR)

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# Classless Addressing

- Classless Addressing is an improved IP Addressing system.
- It makes the allocation of IP Addresses more efficient.
- It replaces the older classful addressing system based on classes.
- It is also known as Classless Inter Domain Routing (CIDR).
- **CIDR Block**
  - When a user asks for specific number of IP Addresses,
    - CIDR dynamically assigns a block of IP Addresses based on certain rules.
    - This block contains the required number of IP Addresses as demanded by the user.
    - This block of IP Addresses is called as a CIDR block.



# Rules For Creating CIDR Block

- A CIDR block is created based on the following 3 rules-
  - **Rule 01**
    - All the IP Addresses in the CIDR block must be contiguous.
  - **Rule-02:**
    - The size of the block must be presentable as power of 2.
    - Size of the block is the total number of IP Addresses contained in the block.
    - Size of any CIDR block will always be in the form  $2^1, 2^2, 2^3, 2^4, 2^5$  and so on.
  - **Rule-03:**
    - First IP Address of the block must be divisible by the size of the block.



# Rules For Creating CIDR Block

- If any binary pattern consisting of  $(m + n)$  bits is divided by  $2^n$ , then-  
Remainder is least significant  $n$  bits Quotient is most significant  $m$  bits
- So, any binary pattern is divisible by  $2^n$ , if and only if its least significant  $n$  bits are 0.
- **Example**
  - Consider a binary pattern- 01100100.00000001.00000010.01000000  
(represented as 100.1.2.64)
  - It is divisible by  $2^5$  since its least significant 5 bits are zero.
  - It is divisible by  $2^6$  since its least significant 6 bits are zero.
  - It is not divisible by  $2^7$  since its least significant 7 bits are not zero.



# CIDR Notation

- CIDR IP Addresses look like- **a.b.c.d / n**
  - They end with a slash followed by a number called as IP network prefix.
  - IP network prefix tells the number of bits used for the identification of network.
  - Remaining bits are used for the identification of hosts in the network
- **Example-**
  - An example of CIDR IP Address is- 182.0.1.2 / 28
  - 28 bits are used for the identification of network.
  - Remaining 4 bits are used for the identification of hosts in the network.



# Problems on CIDR

Q Given the CIDR representation 20.10.30.35 / 27. Find the range of IP Addresses in the CIDR block.

## • Solution

- Given CIDR representation is 20.10.30.35 / 27.
  - 27 bits are used for the identification of network.
  - Remaining 5 bits are used for the identification of hosts in the network.
- Given CIDR IP Address may be represented as-  
00010100.00001010.00011110.00100011 / 27
  - First IP Address = 00010100.00001010.00011110.00100000 = 20.10.30.32
  - Last IP Address = 00010100.00001010.00011110.00111111 = 20.10.30.63
- Thus, Range of IP Addresses = [ 20.10.30.32 , 20.10.30.63]



Q Consider a block of IP Addresses ranging from 100.1.2.32 to 100.1.2.47.

- Is it a CIDR block?
- If yes, give the CIDR representation.

## • Solution

- For any given block to be a CIDR block, 3 rules must be satisfied-
  - **According to Rule-01**, all the IP Addresses must be contiguous.
  - Clearly, all the given IP Addresses are contiguous.
  - So, Rule-01 is satisfied.
  - **According to Rule-02**, size of the block must be presentable as  $2^n$ .
  - Number of IP Addresses in the given block =  $47 - 32 + 1 = 16$ .
  - Size of the block = 16 which can be represented as  $2^4$ .
  - So, Rule-02 is satisfied.
  - **According to Rule-03**, first IP Address must be divisible by size of the block.
  - So, 100.1.2.32 must be divisible by  $2^4$ .
  - $100.1.2.32 = 100.1.2.00100000$  is divisible by  $2^4$  since its 4 least significant bits are zero.
  - So, Rule-03 is satisfied.

## • CIDR Representation

- CIDR Representation = 100.1.2.32 / 28



# Exercise

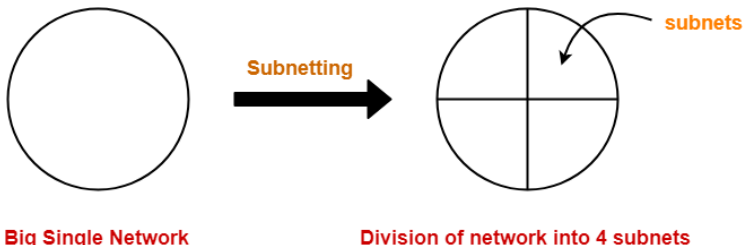
- Q Consider a block of IP Addresses ranging from 150.10.20.64 to 150.10.20.127.
- Is it a CIDR block?
  - If yes, give the CIDR representation.
- Q Given the CIDR representation 100.1.2.35 / 20. Find the range of IP Addresses in the CIDR block.





# Subnetting in Networking

- In networking
  - The process of dividing a single network into multiple sub networks is called as subnetting.
  - The sub networks so created are called as subnets.
- **Example**

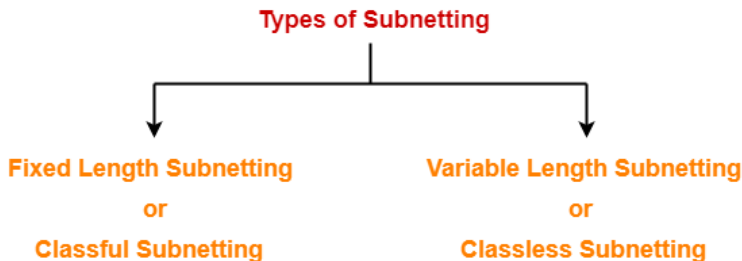


- **Advantages**
  - It improves the security.
  - The maintenance and administration of subnets is easy.



# Subnet ID

- Each subnet has its unique network address known as its Subnet ID.
- The subnet ID is created by borrowing some bits from the Host ID part of the IP Address.
- The number of bits borrowed depends on the number of subnets created.
- **Types of Subnetting**



# Types of Subnetting

- Fixed length subnetting also called as classful subnetting divides the network into subnets where-
  - All the subnets are of same size.
  - All the subnets have equal number of hosts.
  - All the subnets have same subnet mask.
- Variable length subnetting also called as classless subnetting divides the network into subnets where-
  - All the subnets are not of same size.
  - All the subnets do not have equal number of hosts.
  - All the subnets do not have same subnet mask.



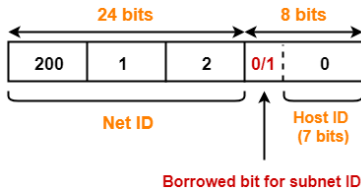
# Example-01

- Consider-

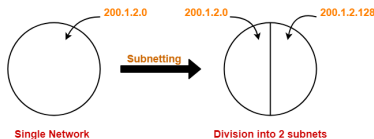
- We have a big single network having IP Address 200.1.2.0.
- We want to do subnetting and divide this network into 2 subnets.

- Solution**

- Clearly, the given network belongs to class C.
- For creating two subnets and to represent their subnet IDs, we require 1 bit.
  - We borrow one bit from the Host ID part.
  - After borrowing one bit, Host ID part remains with only 7 bits.



- If borrowed bit = 0, then it represents the first subnet.
- If borrowed bit = 1, then it represents the second subnet.
- IP Address of the two subnets are-
  - $200.1.2.00000000 = 200.1.2.0$
  - $200.1.2.10000000 = 200.1.2.128$



### • For 1st Subnet

- IP Address of the subnet =  $200.1.2.0$
- Total number of IP Addresses =  $2^7 = 128$
- Total number of hosts that can be configured =  $128 - 2 = 126$
- Range of IP Addresses =  $[200.1.2.00000000, 200.1.2.01111111] = [200.1.2.0, 200.1.2.127]$
- Direct Broadcast Address =  $200.1.2.01111111 = 200.1.2.127$
- Limited Broadcast Address =  $255.255.255.255$



- For 2nd Subnet

- IP Address of the subnet = 200.1.2.128
- Total number of IP Addresses =  $2^7 = 128$
- Total number of hosts that can be configured =  $128 - 2 = 126$
- Range of IP Addresses = [200.1.2.10000000, 200.1.2.11111111] = [200.1.2.128, 200.1.2.255]
- Direct Broadcast Address = 200.1.2.11111111 = 200.1.2.255
- Limited Broadcast Address = 255.255.255.255



## Q Consider-

- We have a big single network having IP Address 200.1.2.0.
- We want to do subnetting and divide this network into 4 subnets.

## Q Consider-

- We have a big single network having IP Address 200.1.2.0.
- We want to do subnetting and divide this network into 3 subnets.

## • Hint:

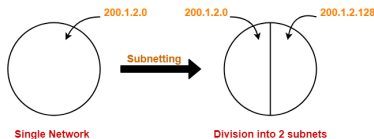
- Here, the subnetting will be performed in two steps-
  - Dividing the given network into 2 subnets
  - Dividing one of the subnets further into 2 subnets



## ● Step-01: Dividing Given Network into 2 Subnets-

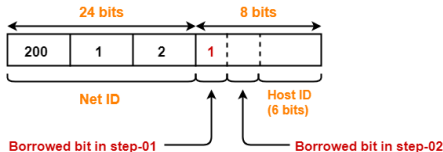
- Dividing One Subnet into 2 Subnets

- We perform the subnetting of one of the subnets further into 2 subnets.
- Consider we want to do subnetting of the 2nd subnet having IP Address 200.1.2.128.



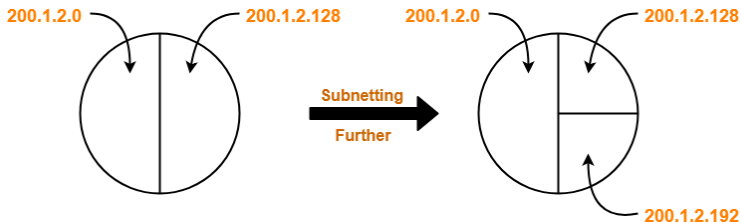
## ● Step-02: Dividing One Subnet into 2 Subnets-

- For creating two subnets and to represent their subnet IDs, we require 1 bit.
- We borrow one more bit from the Host ID part.
- After borrowing one bit, Host ID part remains with only 6 bits





- IP Address of the two subnets are-
  - $200.1.2.10000000 = 200.1.2.128$
  - $200.1.2.11000000 = 200.1.2.192$
- Finally, the given single network is divided into 3 subnets having IP Address-
  - 200.1.2.0
  - 200.1.2.128
  - 200.1.2.192



*Thank You*

