Subnetting

What is Subnetting ?

A subnetwork, or subnet, is a logical subdivision of an IP network.

Now the question arises is that why do we need to do Subneting

Well the answer is that the subnets make networks more efficient. Through subnetting, network traffic can travel a shorter distance without passing through unnecessary routers to reach its destination.

Let's understand this with an example:

Suppose we have a network with some computers on it. If a computer A wants to communicate with computer F, it needs to have its address with him. To get its address, it will start a broadcast which will then be forwarded to every host. Now, every host will broadcast back with kinda Yes and No answers. This can create a loop in the network and will create congestion resulting in massive data loss and delay.

Now that we have understand about the concept of subnetting, let's see what a Subnet Mask is -

Subnet Mask - A subnet mask is a 32-bit address that segregates an IP address into network bits that identify the network and host bits that identify the host device operating on that network.

In Simple terms, A subnet mask is a number that helps divide a network into smaller parts called subnets. It works by separating the IP address into two sections - the network portion and the host portion.

Classes of IP addresses

Check out the values of the subnet mask changing from Class A to Class C here. The Class A subnet mask has one octet that has 255 in it while Class C has 3 octets.

IPv4 Address Classes and Ranges						
Address Class	**Type**	**Range**	**Default Subnet Mask**	**Number of Networks**	**No of Hosts Per Network**	**Use**
A	Public	1.0.0.0 to 127.0.0.0	255.0.0.0	126	16,777,214	Governments and Large Number of Hosts
	Private	10.0.0.0 to 10.255.255.255				
B	Public	128.0.0.0 to 191.255.255.255	255.255.0.0	16,382	65,534	Medium Companies
	Private	172.16.0.0 to 172.31.255.255				
C	Public	192.0.0.0 to 223.255.255.255	255.255.255.0	2,097,150	254	Small Companies and LANs
	Private	192.168.0.0 to 192.168.255.255				
D	N/A	224.0.0.0 to 239.255.255.255	Not Applicable	N/A	N/A	Reserved for Multicasting
E	N/A	240.0.0.0 to 254.255.255.255	Not Applicable	N/A	N/A	Expermential
Special	Special	127.0.0.1 to 127.255.255.255	N/A	N/A	N/A	Loopback Testing

Note:
- Addesses 127.0.0.1 to 127.255.255.255 cannot be used and are reserved for loopback testing

- APIPA address range is 169.254.0.1 to 169.254.255.254 and has 65, 534 usable IP addresses, with the subnet mask of 255.255.0.0.

So, we will make the table again. Now to get 255 in the first octet one has to have all 1s in the first one and all 0s in all the other ones.

Same goes for Class B and C with their respective subnet masks.

Keeping this on hold, let's first understand network and host portion of an IP address.

Network & Host Address

- Network Address - The network address is used to identify the network and is common to all the devices attached to the network. It is denoted by 1. For Example - 192.168.129.82/24. Here the network portion will be 192.168.129
- The host (or node) address is used to identify a particular device attached to the network. It is denoted by 0. For example - 192.168.129.82/24. Here the host portion will be 82.

CIDR

Classless Inter-Domain Routing (CIDR) is a method of IP address allocation and IP routing that allows for more efficient use of IP addresses.

CIDR addresses are represented using a slash notation, which specifies the number of bits in the network prefix. For example, an IP address of 192.168.1.0 with a prefix length of 24 would be represented as 192.168.1.0/24. This notation indicates that the first 24 bits of the IP address are the network prefix and the remaining 8 bits are the host identifier.

Network & Broadcast Address

Now for the host ranges, we have some pre-occupied addresses. These are:

- Network Address - The network address is the first address of the IP subnet.
- Broadcast Address - The broadcast address is the last address of the IP subnet.
- All addresses between the network address and the broadcast address are IP addresses. A network address provides identity to the IP subnet.

Calculate the subnet

So, as we have looked into every major aspect of the subnetting section. Let's calculate the below parameters associated with an IP address.

Here we have a IP address, that is 205.150.65.0/26

and we have to calcuate its

- Class Name
- Network ID
- Broadcast ID
- CIDR
- Subnet Mask
- No. of Subnets
- No. of Hosts

So, the first parameter is the Class Name. We can easily find this out by looking to the table we have made here.

As we can see it is /26 address. As per the table, it will come under the Class C address type.

On that basis, we have our Class name that is - C.

Next is the CIDR, we can easily get in the /notation. So the CIDR here will obviously - /26.

After that, we will calculate the subnet mask. Now, this is interesting.

we know that the CIDR notation of this particular address is /26 which falls under the Class C Type address. So, usually we have this configuration in type C address with 24 bits

C -> 11111111 11111111 11111111 000000 -> 255.255.255.0

Now that we have 26 bits here, we will take 2 from the host portion.

C -> 11111111 11111111 11111111 11000000

Now calculating the subnet mask for this. So, we have 255.255.255 for the first three octets but for the last one we have only two bits.

now adding these bit up - 128+64 which gives us 192.

So the subnet mask will be 255.255.255.192. Isn't that easy?

Next, we have the Network ID and the Broadcast ID.

We will start off with the network ID. Now there is a simple formula to calculate the Network ID of an IP address. That is

Network ID = Network Portion AND Subnet Mask

That means, we have to perform an AND operation between the network portion of IP address which is 205.150.65.0 and the subnet mask we have calculated that is 255.255.255.192.

Now, those who are not aware of the AND Operations. Its really simple.

Basically, An AND operation is a logical operation which takes two input and give result as true only if all the conditions or statements are true.

We can easily perform the AND operations online, without going the manual route. Let's see how

Bit wise calculator - https://miniwebtool.com/bitwise-calculator/

So now we also got our network ID that is 205.150.65.0

Before getting the broadcast ID, we have to calculate two things first. One is the number of subnets that our concerned IP address range can have and how many hosts are possible with them. Let's get right into it.

We will first start off with number of subnets. For this, we have a formula too.

No. of subnet = 2 (power n)

here we are taking the extra bits as n. as we have 26, so we have two extra bits from Class C address range. Typically, it has /24 network range that means 24 bits but we stole 2 bits from its host portion. So, the power of n to calculate subnet will be 2.

In that case, 2 to the power 2 will give us 4. That means, we can have 4 subnets with this IP address range.

Next, is the number of hosts. To calculate this, we will use the formula

No of hosts - 2(power n-2)

Now here the n = The renaming bits in the last octet. So the last octet has 8 bits in it. Out of 8, 2 we have already stole for our subnet. So, the remaining number of bits will be 6.

Keeping that in picture, the number of host will be 2 to the power 6 that is 64 and then we will do a -2 to it as two IP addresses are reserved for network and broadcast IPs. So, the no. of hosts we can have is 62.

At last, we will find out the broadcast IP of our address range. As we now know that the maximum no. of host can be 62. So, by default the last IP address becomes the broadcast IP. With that logic, our broadcast IP will be 205.150.65.63.

So, that's how you manually calculate the subnet mask and associated entities with it. There is also a automated way of doing this. Like i found this amazing website.

Calculator - https://jodies.de/ipcalc

Here you just have to put your IP address and the network range, it will calculate everything for you.
