9c. use logical AND to determine network address

1. Why would you choose different subnet masks when setting up your IP configuration?

Subnet mask allow mathematically filter your LAN where communication starts from discovering MAC of required target from outside where communication starts from sending packets to configured gateway which is responsible for further communication. Shortly : LAN - find MAC (wait for ARP reply)- set connection (like handshake etc) - communicate (exchange packets, ACK). WAN - send packets to gateway - wait for TCP/UDP/ICMP reply - set connection, communicate

2. Why is a subnet mask required in an IP address?

There is a solid reason for it.

You see, an IP address is not just a unique identifier.

It has a HIERARCHICAL DESIGN - in that it not only contains the NETWORK ID but also the IP ADDRESS identifying the specific host on this specific network.

The Subnet mask exists to help you figure out your NETWORK ID.

Subnetting can be one of the most confusing concepts to learn - IF you do not have the right person to teach you this.

I hope to be able to put up a FREE Subnetting training video on Youtube sometime soon - stay tuned through my Blog on my BIO section.

3. What is the purpose of a subnet and its net mask?

The goal of subnetting is to create a fast, efficient, and resilient computer network. As networks become larger and more complex, the traffic traveling through them needs more efficient routes. If all network traffic was traveling across the system at the same time using the same route, bottlenecks and congestion would occur resulting in sluggish and inefficient backlogs.

➢ Logical AND between the subnet mask:

When it comes to binary and the idea of logical AND, you can refer to a table that looks like this:
input | output
0 0 | 0
0 1 | 0

1 0 | 0
1 1 | 1

In other words, it takes two 1 inputs to get a 1 output.

IP addresses are binary, even though we use decimal numbers between 0 and 255 to talk about them. That means, if you're talking about an IP address of 10.0.0.1 with a subnet mask of 255.255.255.0, you're actually saying this:

IP 00001010000000000000000000000001
Subnet 11111111111111111111111100000000

They don't line up here, but both lines are the actual binary equivalent of the IP and subnet.

So, the definition of a network address is "All host bits are set to 0". By ANDing the IP and the Subnet mask, you end up automatically with the network address. Let's look at the first 8 bits of both the IP and subnet mask above:

IP 0 0 0 0 1 0 1 0 - This is the number 8 decimal. The 2 and 8 columns have 1's in them, so 2 + 8 = 10. That's where we get the first decimal number in the IP of 10.
Subnet 1 1 1 1 1 1 1 1 - If all the bits in a byte are set to 1, that's 1+2+4+8+16+32+64+128 which is 255.

Now, if we AND the two binary numbers together, things look like this:

0 0 0 0 1 0 1 0
1 1 1 1 1 1 1 1
_____ ANDed
0 0 0 0 1 0 1 0

Notice that the original pattern 00001010 is not changed after the AND! The subnet mask of 255 leaves all of the first 8 bits the same as they were before. With the subnet of 255.255.255.0, the first 24 bits of the subnet mask will be 1's, and the last 8 bits will be all 0's.

So, if I AND the last 8 bits of the IP and the Subnet Mask, it looks like this:
0 0 0 0 0 0 0 1
0 0 0 0 0 0 0 0
_____ANDed
0 0 0 0 0 0 0 0

Notice that the very last 1 in the IP address binary gets turned into a 0? That's because AND requires two 1 inputs to get a 1 output. The definition of a network address is "All host bits

are set to 0". The subnet mask of 255.255.255.0 turns the IP address of 10.0.0.1 into 10.0.0.0, which is the network, or first, address in the range of IPs.

Don't forget that an IP with a subnet mask actually belongs to a range of IPs. There is the first IP called the Network address. All host bits are 0s. The last IP is called the Broadcast address, and all host bits are 1's. Neither of those IPs can be put onto an interface. They define the edges of the range. The subnet of 255.255.255.0 with an IP address of 10.0.0.1 actually tells me 4 pieces of information:

Network Address: 10.0.0.0 (all host bits set to 0)
First Usable Address: 10.0.0.1 (binary 1 added to the network address)
Last Usable Address: 10.0.0.254 (binary 1 subtracted from broadcast address)
Broadcast Address: 10.0.0.255 (all host bits set to 1)

So, knowing this, I can figure out all kinds of IP ranges...

172.16.6.33 is the IP, and the Subnet mask is 255.255.0.0. Remember, the rules don't care if you go over the dot or not. The subnet mask above means the first 16 bits are Network, and the last 16 bits are host.