Video - The Subnet Mask (8 min)

Now, I want to take a moment to point out that Subnetting makes sense from the binary perspective. In other words, when we take the IP address and the Subnet Mask and convert them to binary, I have the IP address on this row, here, I have the Subnet Mask on this row, converted to binary, that the computer and the router are able to logically AND, or combine, the IP address and the Subnet Mask and find the network address. In other words, this ANDing process is a logical process of ANDing. So, a true and a true makes a true. True, true, true, false and a true makes a false. And if we do that, and AND, logically AND the IP address with the Subnet Mask, we get the network address. So, 192.168.1.10, logically ANDed with 255.255.255.0 produces the 192.168.1.0 network. This is at the core of the IPv4 address and Subnet Mask and Subnetting in general. What about Non Classful Subnet Masks? We've seen that the class C Subnet Mask is /24. We've seen the class B Subnet Mask, /16, and the class A Subnet Mask, /8. But what if we use classless masks? In other words, what if we have a /25 Subnet Mask? Or a /18 Subnet Mask, creating a 255.255.192.0 Subnet Mask, or for that matter, a /12 Subnet Mask. 255.240.0.0, how does that work? And how does that change the networks that are created by the combination of the IP address and the Subnet Mask? This is called Subnetting. I'll explain it using an example scenario. Let's start with a classic class C network like 192.168.1.0 with a /24 or 255.255.255.0 Subnet Mask. If we want to Subnet this 192.168.1.0 network, what we need to do is go into the Subnet Mask in binary, which we can see on this row, right here, and what we do is, to change the Subnet Mask, we borrow bits from the host portion of the address. This is done from left to right.

So, I could take this first 0 here on the left, and change it to a 1, and now I've effectively changed the Subnet Mask from /24 to /25. In other words, if I convert this back to decimal, it's now 255.255.255.128. This completely changes the nature of the network. We now have a /25 Subnet Mask and we only have seven host bits. So, starting from a /24, we now have borrowed one bit from the host portion. We call this one bit a Subnet bit. If we look at it from the perspective that we started with /24, we've added one bit. So we could say that Subnet bits, we now have one bit, or two to the first power, creating two Subnetworks. Host bits, we have seven zeros, now. So Host bits are two to the seventh power or 128-2, for the network address and the broadcast address, leaving with us with a total number of possible hosts on the Subnets of 126. So by borrowing one bit from the host portion of the address we create two Subnetworks, each Subnetwork with 126 hosts. The Subnetworks are the 192.168.1.0 /25 Subnetwork. And the 192.168.1.128 Subnetwork /25. We can prove that this is the case using logical ANDing to prove how the router or computer would take an IP address with this particular /25 Subnet Mask and derive the resulting network address. In other words, let's put in a host address. I'll put in the host address here, and I'll say, let's put in the address 68. So I changed this to a 68.

So now I've got host 192.168.1.68, so this needs to be a one, that's the 64 and then we need to add the four bit, here so now we have 68. If we logically AND the IP address, here with our new Subnet Mask /25, here, let's see the result. We'll get a 1, a 1, a 0, 0, 0, 0, 0. So that's 192. And then here, the result is 10101-- 168 and then all zeros here, and a 1. This is a 1, and now if we look at this last octet, a false and a true makes a false. A true and a false makes a false. And then we get all zeros here, so the address, the network address is the 192.168.1.0 network. So, host number 68 is on the zero network. Well this makes sense because if the next Subnet is 128, if we put a host address larger than 128, we'll see if it falls in this Subnetwork. So let's change it, slightly. I'll change the host address it 138.

So now I'll change this, put that a 0. So there's a 128 bit, I'll make this a 1. And I'll put a 1 here. So 128 plus eight, plus two is 138. If we do the ANDing again, we see that a true and a true makes a true. And then we have false's all the way and now, the resulting network address is 128 so when we take the IP address with the /25 Subnet Mask, we see that the network address is 192.168.1.128. So we've created two Subnetworks from the single 192.168.1.0/24 network, we've created two Subnetworks. The Subnetworks go from 1.0 all the way up to 1.127 with zero being the network address and 127 being the broadcast address. And the second Subnetwork starts at 128. So this is the network address because it's the first address all the way up to 255, and since this is the last address, this is the broadcast address. In other words, the first address in the Subnet is the network address and the last address in the Subnetwork is the broadcast address. This process is called Subnetting.