Video – IPv4 vs. IPv6 (8 min)

IPv4 addresses are 32 bit addresses and IPv6 addresses are 128 bit addresses, but typically IPv4 addresses are represented in dotted Decimal notation and IPv6 addresses are represented by colon-separated Hexadecimal notation. The difference between Decimal, Hexadecimal, and Binary is that the Decimal number system is Base 10, having 10 numbers, zero through nine. The Hexadecimal number system is Base 16, having numbers zero through nine, plus A, B, C, D, E, and F, which stand for 10, 11, 12, 13, 14, and 15, respectively. The Binary number system is Base 2, having only two numbers, zero or one. So when we say that the IPv4 address is a 32 bit address and an IPv6 address is a 128 bit address, we need to first convert the addresses to Binary.

You can see here that the IPv4 address 192.168.1.100 has been converted to Binary, and we have 32 ones and zeros. The IPv6 address has also been converted to Binary and it's been converted to 128 ones and zeros. In IPv4, we call these octets. There are four octets, or four groupings of eight bits in an IPv4 address, and in an IPv6 address we have eight hextets, or eight groupings of 16 bits in each portion of an IPv6 address. IPv4 addresses have subnet masks. You can see here we have 192.168.1.100 with a 255.255.255.0 subnet mask. A subnet mask can also be written in slash notation. In this case, 192.168.1.100 slash 24. The slash notation only makes sense when you think of the subnet mask in Binary. In other words, 255.255.255.0 can be converted to Binary and in Binary, we can see that it's 24 ones, followed by eight zeros. Hence, the slash 24 notation. Subnet masks typically default to slash 24 255.255.255.0, slash 16 255.255.0.0, and slash 8 255.0.0.0. We can see those subnet masks here converted to their Binary equivalents. This makes finding the networks and the hosts easy. With IPv4, the ones in the subnet mask define the network. In other words, if we have the host 192.168.1.100 with a 255.255.255.0 subnet mask, the 255s tell us where the network is. It's the 192.168.1 network. The zero in the subnet mask tells us where the hosts are. In this case, it's host number 100.

Similarly, the 172.16.2.33 address has a 255.255.0.0 subnet mask. The subnet mask let us know that it's the 172.16 network, and that this is host 2.33. In the 10.100.100.2 host address, the subnet mask is 255.0.0.0 and this let us know that it's the 10 network, with host number 100.100.2. So looking at the subnet mask in Binary, the ones defines the network and the zeros define the hosts. With CIDR, or Classless Inter-Domain Routing, subnet masks can be different than slash 24, slash 16, or slash 8. We could have, for instance, a slash 26 subnet mask which would be 255.255.255.192. Or, we could have a slash 19 subnet mask 255.255.224.0. Or, we could have a slash 14 subnet mask 255.252.0.0. There's all kinds of possibilities beyond just slash 24, slash 16, and slash 8. With CIDR, the subnet masks are not so easily defined as slash 24, slash 16, or slash 8. If you take the 192.168.1.0 network slash 24 and convert the subnet mask to slash 26, you effectively subnet the network. So instead of the 192.168.1.0 network, you'd now have four subnets. The 192.168.1.0 subnet, the 192.168.1.64 subnet, the 192.168.1.128 subnet, and the 192 subnet. Each subnet is a separate network with separate usable host addresses.

IPv6 addresses have network prefixes instead of subnet masks. There are no subnet masks in IPv6. So you can see with this IPv6 address, the network prefix is slash 64. The network prefix tells us how to identify the network. In this case, the first 64 bits of the address, or the 2001:DB8:7AC:1F, defines the network, and the remaining 64 bits is the host identifier. IPv6 addresses are typically presented in a compressed format. For instance, if we look at this IPv6 address, it's been compressed.

Let's take a look at it in the decompressed format. In the decompressed format, the leading zeros were omitted, so 2001:DB8 is really 2001:0DB8, and 7AC is 07AC. And the 1F is 001F, and towards the end of the address the double F is actually 00FF. This is because leading zeros in IPv6 addresses can be omitted. Similarly, contiguous zeros can be replaced with a double colon in an IPv6 address. If we look at this IPv6 address, you can see that there's a string of six zeros in a row. This can be replaced with a double colon. The double colon can only be used once in an address. So you can see here in the address, the leading zeros were omitted, as well as, the double colon used to replace the six zeros in a row, before the FF.