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### CISC 4331 – Systems and Network Administration - Week 3

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# CISC 4331 – Systems and Network Administration

WEEK 3

# Subnetting Continued

- ▶ There are a couple of ways to create subnets. In this article we will subnet a class C address **192.168.0.0** that, by default, has **24** subnet bits and **8** host bits.
- ▶ Before we start subnetting, we have to ask ourselves these two questions:
- ▶ **How many subnets do we need?**
- ▶  $2^x$  = number of subnets. **x** is the number of 1s in the subnet mask. With 1 subnet bit, we can have  $2^1$  or 2 subnets. With 2 bits,  $2^2$  or 4 subnets, with 3 bits,  $2^3$  or 8 subnets, etc.
- ▶ **How many hosts per subnet do we need?**
- ▶  $2^y - 2$  = number of hosts per subnet. **y** is the number of 0s in the subnet mask

# Subnetting Continued

- ▶ An example will help you understand the subnetting concept. Let's say that we need to subnet a class C address **192.168.0.0/24**. We need two subnets with **50** hosts per subnet. Here is our calculation:
- ▶ Since we need only two subnets, we need  $2^1$  subnet bits. In our case, this means that we will take one bit from the host part. Here is the calculation:
- ▶ First, we have a class C address 192.168.0.0 with the subnet mask of 24. Let's convert them to binary:
- ▶ **192.168.0.0 = 11000000.10101000.00000000.00000000**  
**255.255.255.0 = 11111111.11111111.11111111.00000000**
- ▶ We need to take over a single zero from the host part of the subnet mask. Here is our new subnet mask:
- ▶ **255.255.255.128 = 11111111.11111111.11111111.10000000**

# Understanding Subnetting

- ▶ Subnetting allows you to create multiple logical networks that exist within a single Class A, B, or C network. If you do not subnet, you are only able to use one network from your Class A, B, or C network, which is unrealistic.
- ▶ Each data link on a network must have a unique network ID, with every node on that link being a member of the same network. If you break a major network (Class A, B, or C) into smaller subnetworks, it allows you to create a network of interconnecting subnetworks. Each data link on this network would then have a unique network/subnetwork ID. Any device, or gateway, that connects  $n$  networks/subnetworks has  $n$  distinct IP addresses, one for each network / subnetwork that it interconnects.
- ▶ In order to subnet a network, extend the natural mask with some of the bits from the host ID portion of the address in order to create a subnetwork ID. For example, given a Class C network of 204.17.5.0 which has a natural mask of 255.255.255.0, you can create subnets in this manner:
- ▶ 204.17.5.0 - 11001100.00010001.00000101.00000000
- ▶ 255.255.255.224 - 11111111.11111111.11111111.11100000

# Subnetting Examples

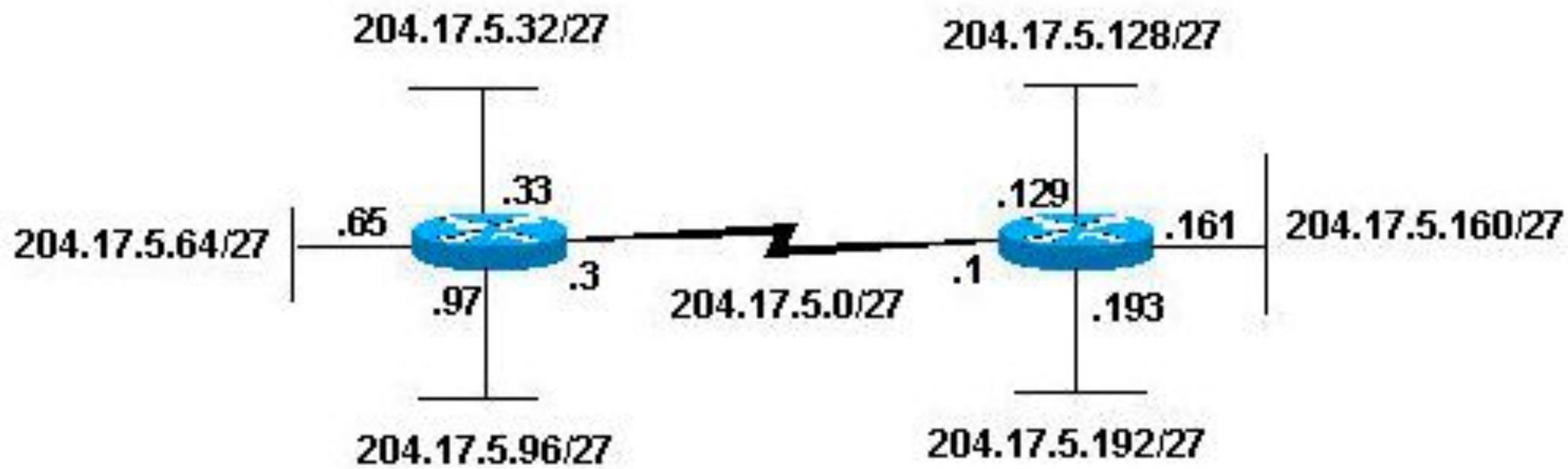
- ▶ By extending the mask to be 255.255.255.224, you have taken three bits (indicated by "sub") from the original host portion of the address and used them to make subnets. With these three bits, it is possible to create eight subnets. With the remaining five host ID bits, each subnet can have up to 32 host addresses, 30 of which can actually be assigned to a device *since host ids of all zeros or all ones are not allowed* (it is very important to remember this). So, with this in mind, these subnets have been created.
- ▶ 204.17.5.0 255.255.255.224 host address range 1 to 30
- ▶ 204.17.5.32 255.255.255.224 host address range 33 to 62
- ▶ 204.17.5.64 255.255.255.224 host address range 65 to 94
- ▶ 204.17.5.96 255.255.255.224 host address range 97 to 126
- ▶ 204.17.5.128 255.255.255.224 host address range 129 to 158
- ▶ 204.17.5.160 255.255.255.224 host address range 161 to 190
- ▶ 204.17.5.192 255.255.255.224 host address range 193 to 222
- ▶ 204.17.5.224 255.255.255.224 host address range 225 to 254

# Subnetting Continued

- ▶ Remember, the ones in the subnet mask represent the network.
- ▶ We need 50 hosts per subnet. Since we took one bit from the host part, we are left with seven bits for the hosts. Is it enough for 50 hosts? The formula to calculate the number of hosts is  $2^y - 2$ , with  $y$  representing the number of host bits. Since  $2^7 - 2$  is 126, we have more than enough bits for our hosts.
- ▶ Our network will look like this:
- ▶ **192.168.0.0/25** – the first subnet has the subnet number of **192.168.0.0**. The range of IP addresses in this subnet is **192.168.0.0 – 192.168.0.127**.
- ▶ **192.168.0.128/25** – the second subnet has the subnet number of **192.168.0.128**. The range of IP addresses in this subnet is **192.168.0.128 – 192.168.0.255**

# Subnetting Examples

- ▶ In a Class A address, the first octet is the network portion, so the Class A example in [Figure 1](#) has a major network address of 1.0.0.0 - 127.255.255.255. Octets 2, 3, and 4 (the next 24 bits) are for the network manager to divide into subnets and hosts as he/she sees fit. Class A addresses are used for networks that have more than 65,536 hosts (actually, up to 16777214 hosts!).
- ▶ In a Class B address, the first two octets are the network portion, so the Class B example in [Figure 1](#) has a major network address of 128.0.0.0 - 191.255.255.255. Octets 3 and 4 (16 bits) are for local subnets and hosts. Class B addresses are used for networks that have between 256 and 65534 hosts.
- ▶ In a Class C address, the first three octets are the network portion. The Class C example in [Figure 1](#) has a major network address of 192.0.0.0 - 223.255.255.255. Octet 4 (8 bits) is for local subnets and hosts - perfect for networks with less than 254 hosts.
- ▶ **Network Masks**
- ▶ A network mask helps you know which portion of the address identifies the network and which portion of the address identifies the node. Class A, B, and C networks have default masks, also known as natural masks, as shown here:
- ▶ Class A: 255.0.0.0 Class B: 255.255.0.0 Class C: 255.255.255.0



# Subnetting Examples

- ▶ **Determine the Subnet for DeviceA:**
- ▶ 172.16.17.30 - 10101100.00010000.00010001.00011110
- ▶ 255.255.240.0 - 11111111.11111111.11110000.00000000
- ▶ ----- | sub | -----
- ▶ subnet = 10101100.00010000.00010000.00000000 = 172.16.16.0
- ▶ Looking at the address bits that have a corresponding mask bit set to one and setting all the other address bits to zero (this is equivalent to performing a logical "AND" between the mask and address), shows you to which subnet this address belongs. In this case, DeviceA belongs to subnet 172.16.16.0.

# Subnetting Examples

- ▶ **Determine the Subnet for DeviceB:**
- ▶ 172.16.28.15 - 10101100.00010000.00011100.00001111
- ▶ 255.255.240.0 - 11111111.11111111.11110000.00000000
- ▶ ----- | sub | -----
- ▶ subnet = 10101100.00010000.00010000.00000000 = 172.16.16.0
- ▶ From these determinations, DeviceA and DeviceB have addresses that are part of the same subnet.