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Computer Networks

Assignment 2 – Subnets

1. IPv4 Subnetting

a) A network mask tells which portion of an address identifies the network and which portion identifies the node of the address. Class D addresses are ranged from 224 to 239 (224.0.0.0 – 239.255.255.255) and are used for multicasting. They are not divided into smaller networks (subnets), and therefore do not have any network mask (like class A, class B and class C do).

b) A network mask for class B address has a default mask of 255.255.0.0, or in binary representation 11111111.11111111.00000000.00000000. Any address bits that have corresponding mask bits set to 1 represents the network ID, and any bits that have mask bits set to 0 represent the node ID.

So, for a class B address, the first two octets are the network portion, and the second two octets are for local subnets and hosts.

c) Using CIDR (Classless Interdomain Routing) an IP network is represented by a prefix, which is an IP address and some indication of the length of the mask. In this particular case, the IP address is "192.5.23.132" and the length of the mask is "/9".

By length is meant the number of left-most contiguous mask bits that are set to one. So, here the number of bits set to one are 9 in total, or in binary: 11111111.10000000.00000000.00000000

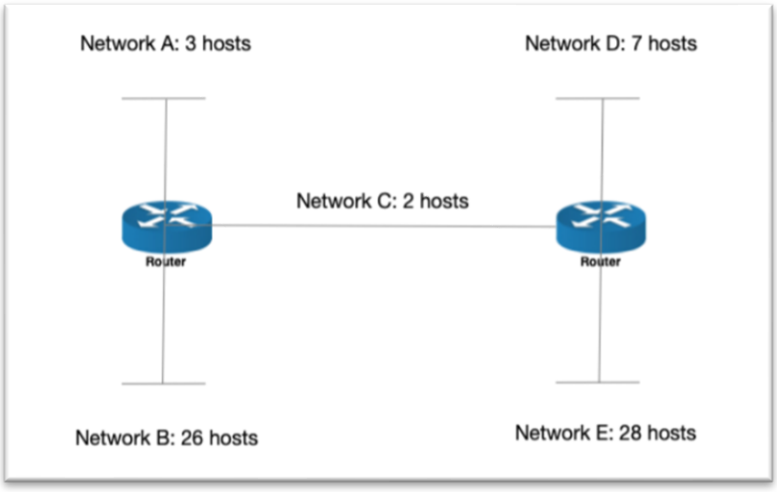
This donates the network 192.5.23.132 255.1.0.0 where 9 bits are set in the subnet mask, as previously mentioned.

d) By extending the mask to be 255.1.0.0 (or 11111111.100000000.00000000.00000000 in binary), we have taken 1 bit from the original host portion of the address and used to make a subnet. With this single bit, it is possible to create two subnets (2^1). With the remaining 15 host ID bits, each subnet can have up to 8,388,605 host addresses that can actually be assign to a device. For the two subnets, the total number of host would therefore be 16,777,210.

Source:
https://www.cisco.com/c/en/us/support/docs/ip/routing-information-protocol-rip/13788-3.html#anc6

2.

a) Looking at the picture of the network below, we are required to make 5 subnets, with the largest subnet being able to support 28 host addresses.



Class C network of 10.5.12.0/24

The IP address of the network is 10.5.12.0, and the binary representation of this would be:

00001010.00000101.00001100.00000000

The default network mask for Class C is 255.255.255.0, which in binary representation would be:

11111111.11111111.11111111.00000000

Therefore, we have 24 bits for the network ID (shown as 1's), and 8 bits for the host ID (shown as 0's).

To be able to create five subnets, we require three bits from the Class C host bits, as $2^3 = 8$ subnets. (and $2^2 = 4$ subnets, which is less than 5 which is required and therefore not sufficient enough).

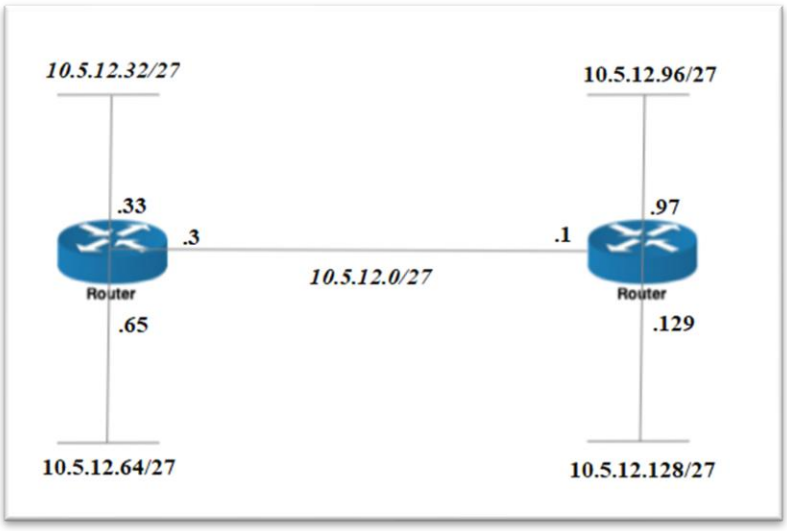
Therefore, to be able to subnet the network we extend the natural mask to be 255.255.255.244 (CIDR), which in binary representation would then be:

11111111.11111111.11111111.11100000

By this extension to the mask, we have used three bits of the host ID (indicated in red colour) 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 (as stated previously above). With the remaining five host IDs bits, each subnet can have up to 32 host addresses, and 30 of them which can be assigned to a device (excluding id with all zeros and all ones.

Thereby, the following subnets have been created:

Network	**IP address**	**CIDR**	**Host ID**
C	10.5.12.0/27	255.255.255.244	host address range 1 to 30
A	10.5.12.32/27	255.255.255.244	host address range 33 to 62
B	10.5.12.64/27	255.255.255.244	host address range 65 to 94
D	10.5.12.96/27	255.255.255.244	host address range 97 to 126
E	10.5.12.128/27	255.255.255.244	host address range 129 to 158
-	10.5.12.160/27	255.255.255.244	host address range 161 to 190
-	10.5.12.192/27	255.255.255.244	host address range 193 to 222
-	10.5.12.224/27	255.255.255.244	host address range 225 to 254



The newly created subnetwork

b)

Step 1 - Subnets possible:

Subnet mask	Slash notation	Hosts/Subnets
255.255.255.0	/24	254
255.255.255.128	/25	126
255.255.255.192	/26	62
255.255.255.224	/27	30
255.255.255.240	/28	14
255.255.255.248	/29	6
255.255.255.252	/30	2

Step 2 – Requirements of IPs:

Requirements of IPs
Network D – 28 hosts
Network A – 16 hosts
Network E – 15 hosts
Network C – 5 hosts
Network B – 2 hosts

Step 3 – Allocate range of IPs to requirements:

Network D: requires a /27 (**CIDR: 255.255.255.224**) mask to support 28 hosts
Network A: requires a /27 (**CIDR: 255.255.255.224**) mask to support 16 hosts
Network E: requires a /27 (**CIDR: 255.255.255.224**) mask to support 15 hosts
Network C: requires a /29 (**CIDR: 255.255.255.248**) mask to support 5 hosts
Network B: requires a /30 (**CIDR: 255.255.255.252**) mask to support 2 hosts

Network	IP address	Host ID
D	10.5.12.0/27	host address range 1 to 30
A	10.5.12.32/27	host address range 33 to 62
E	10.5.12.64/27	host address range 65 to 94
C	10.5.12.96/29	host address range 97 to 102
B	10.5.12.104/30	host address range 105 to 106

Sources:
https://www.cisco.com/c/en/us/support/docs/ip/routing-information-protocol-rip/13788-3.html#anc6
https://www.tutorialspoint.com/ipv4/ipv4_vlsm.htm

3. Network Address Translation

a)

Sequence no.	Address (from)	Port	Address (to)	Port
1.	192.168.1.30	8080	192.168.1.22	1337
2.	192.168.1.22	1337	44.17.21.8	1234
3.	44.17.21.8	1234	18.27.5.107	54121
4.	18.27.5.107	54121	44.17.21.8	1234
5.	44.17.21.8	1234	192.168.1.22	1337
6.	192.168.1.22	1337	192.168.1.30	8080

b) According to the Home Network given, there is no such device with a given IP address of 133.17.21.8 (port 8080), but the NAT box would presumable look for this device and if not found it would simple drop that package.

c) If the laptop is trying to connect to a local printer, the laptop would first connect to the Internal NAT. The NAT would then look and try find a printer within the local network. If found, the print request is sent to that printer, which sends notification that it has received the request and is processing it. If however the printer is not found within the local network, the package is dropped and the request made by the laptop is given an error message.

d) NAT device performs address translation, creates a forwarding table between the internal hosts and a single external IP address, and hides the internal network from view, but does not make routing decisions. The maximum number of connections a NAT box can therefore support, holds hand in hand with the total number of ports that the NAT box can provide. Without a port, it cannot establish a connection, and therefore is limited to this source (16 bits approximately 60,000 connections).

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Time Taken: 6.25 hrs
Estimated time: 6 hrs