

from <http://vivektechsolutions.blogspot.com/2009/09/subnetting-what-when-and-how.html>

IP ADDRESSING REVIEWED

An IP address is a 32 bit number divided into 4 sections of 8 bits called octets. Each octet is usually converted from binary to decimal form and separated with a dot to make it readable. The address can also be split into a network and host portion.

The network portion always remains fixed for a particular network, while the remaining bits which make up the host portion can be altered to give the range of addresses to assign to hosts.

In order to determine where the network portion ends and the host portion begins, a subnet mask (or netmask, or just mask) is used to fix the network portion and allow the host portion to be changed. As an example, we will use the IP number 38.9.211.0 with a subnet mask of 255.255.255.0. Changing to binary, we get:

Mask: 255.255.255.0 = 11111111.11111111.11111111.00000000
Number: 38.9.211.0 = 00100110.00001001.11010011.00000000

Network Portion **Host-number bits**

A binary 1 will "mask" the bit, and a 0 will deem it variable. So, for this case, we refer to the netmask as 24 bits, or /24

.38.9.211.0/24

The fixed bits become the network portion and the remaining bits become the host portion, so in this case there are 8 host bits which account for a range from 0-255. IP protocol standards dictate that we use addresses of all 0's to refer to the network as a whole, and addresses of all 1's to refer to the broadcast of all hosts on the network, so these host addresses may not be used. This limits our host range from 1 - 254.

38.9.211.0/24	the entire /24 network
38.9.211.1 - 38.9.211.254	range of valid hosts
38.9.211.255	broadcast address of all hosts on the network

FIXED MASK SUBNETTING

Once you receive your network number, whether it's a /24, /25, or /27, you have the ability to extend the network portion further into the host-number field by lengthening the netmask. The number of bits that you extend into the original host portion determines how many segments, or subnets, you will produce.

To be specific, lengthening the mask by n bits will produce 2^n subnets.

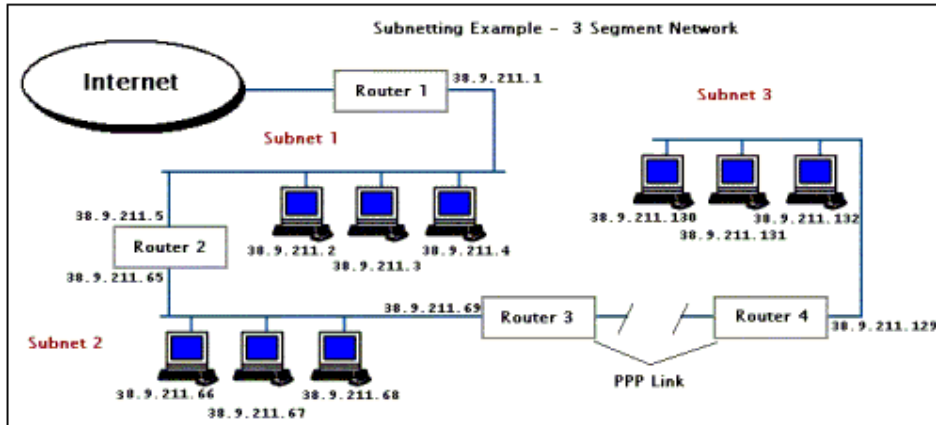
Let's illustrate what would happen if we used 2 subnet bits. The host portion would be reduced to six bits. There are 4 different combinations of arranging the 2 subnet bits, so we arrive at 4 unique subnets.

Subnet 1	00000000 - 00111111	(.0 - .63)
Subnet 2	01000000 - 01111111	(.64 - .127)
Subnet 3	10000000 - 10111111	(.128 - .191)
Subnet 4	11000000 - 11111111	(.192 - .255)

What we have accomplished is creating 4 network numbers from 1. Once again, adhering to our rule that all 0's is a network, and all 1's is a broadcast, we can see where each subnetwork begins and ends.

Network	Host Ranges	Broadcast
38.9.211.0/26 **	38.9.211.1 - 38.9.211.62	38.9.211.63
38.9.211.64/26	38.9.211.65 - 38.9.211.126	38.9.211.127
38.9.211.128/26	38.9.211.129 - 38.9.211.190	38.9.211.191
38.9.211.192/26 **	38.9.211.193 - 38.9.211.254	38.9.211.255

Sample Fixed mask Subnetting Topology



Each router and workstation will use a 255.255.255.192 **subnet mask** in its IP configuration. The default gateway will always be the IP address of the closest router to the Internet on the segment.

TCP/IP Config .

Subnet 3 - [38.9.211.128/26](#) **X.X.X.1000000**

The following use 38.9.211.129 as a default gateway:

38.9.211.130
38.9.211.131
38.9.211.132

Subnet 2 - [38.9.211.64/26](#) **X.X.X.0100000**

The following use 38.9.211.65 as a default gateway:

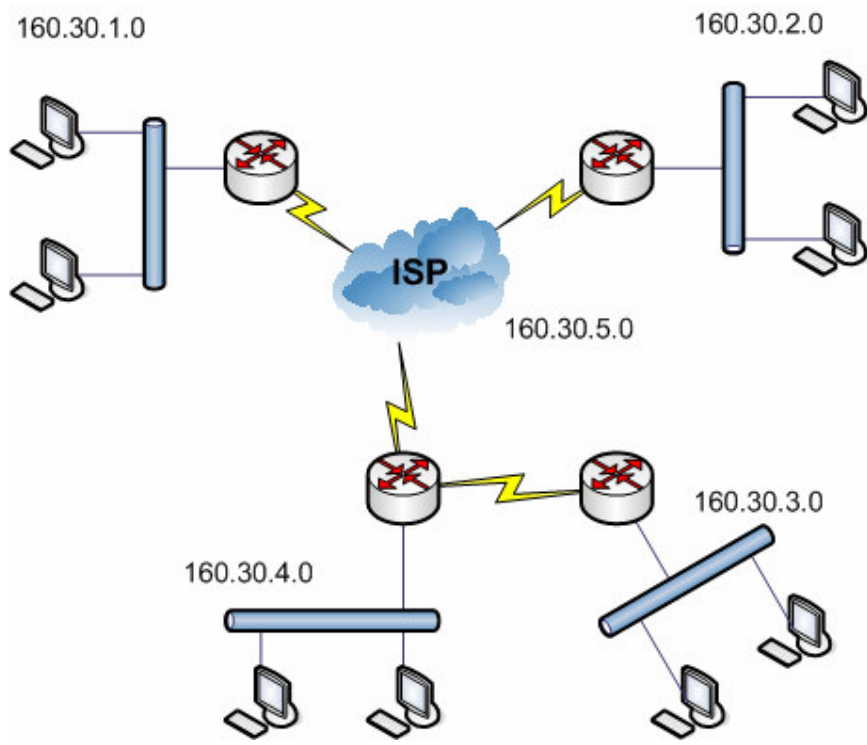
38.9.211.69
38.9.211.68
38.9.211.67
38.9.211.66

Subnet 1 - [38.9.211.0/26](#) **X.X.X.0000000**

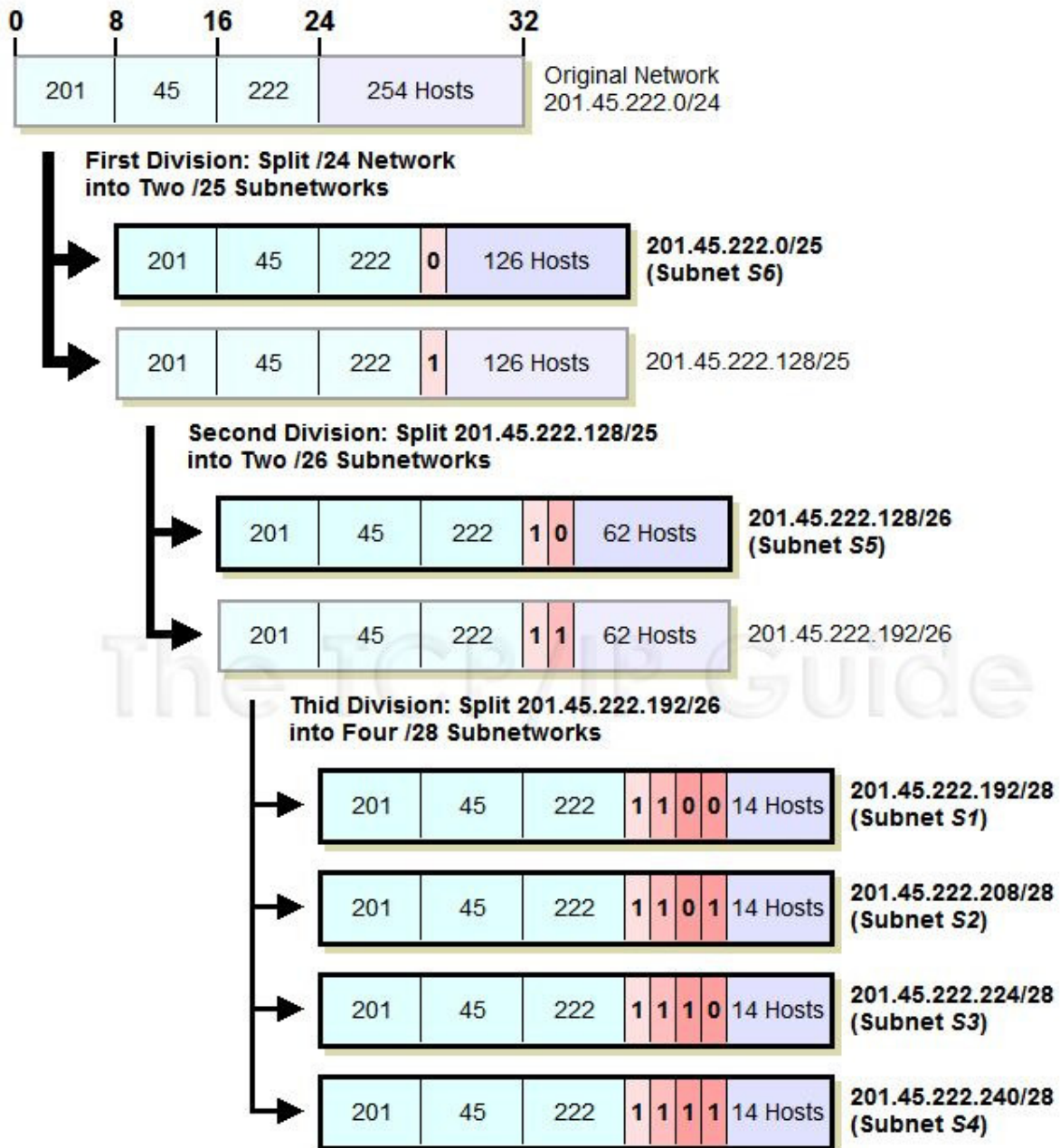
The following use 38.9.211.1 as a default gateway:

38.9.211.5
38.9.211.4
38.9.211.3
38.9.211.2

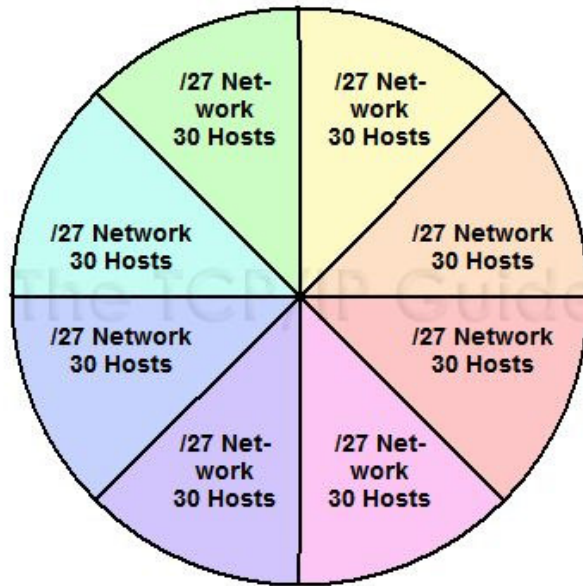
not used subnet **X.X.X.1100000** i.e. [38.9.211.192/26](#)



VLSM Subnetting Example

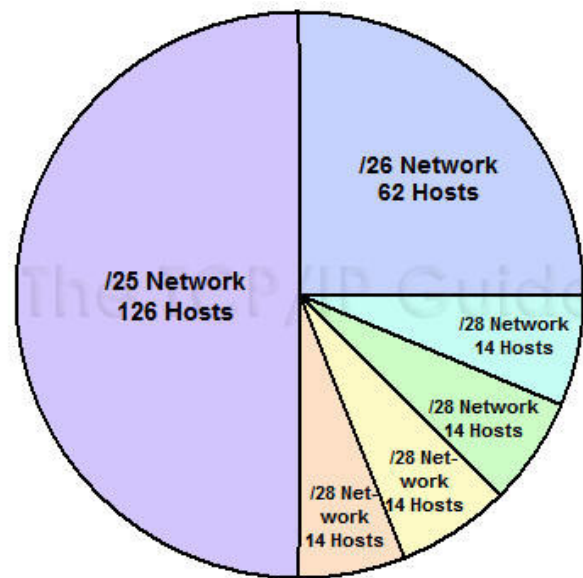


The Class C (/24) Network Split Into Eight Fixed Mask Subnets



Class C (/24) Network (254 Hosts)

The Class C (/24) Network Split Using Variable Length Subnet Masking (VLSM)



Class C (/24) Network (254 Hosts)