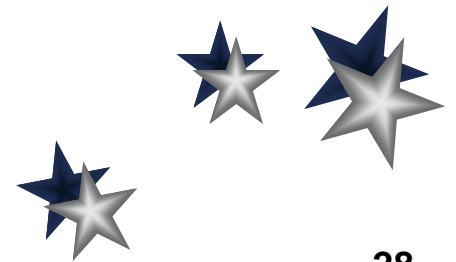
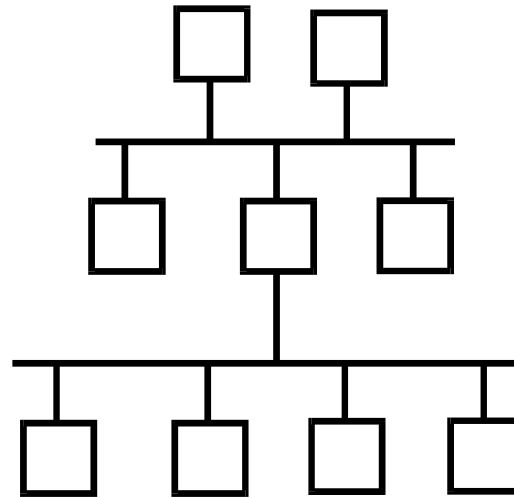


# Subnetting

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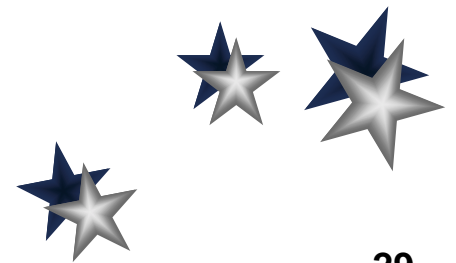


# Subnetting: Why ???

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- Network has exceeded limits of a single LAN and run out of IP Addresses
- Isolate traffic of a specific node or group of nodes
- Divide a network into logical segments
- Improve throughput of network

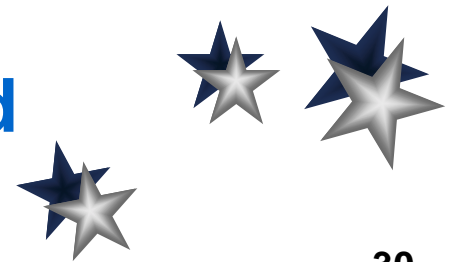


# Subnetting: Definition

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- An optional addressing scheme that allows you to partition the host address portion of an IP address into discrete subnetworks
- Implemented by the keywords **netmask** or **subnet mask** which identifies the bits used to mask out the network portion of the IP Address
- Network portion is always masked out by using binary 1's

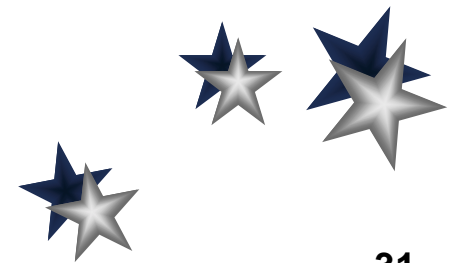


# Subnetting: Binary

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00000001	$2^0 = 1$
00000010	$2^1 = 2$
00000100	$2^2 = 4$
00001000	$2^3 = 8$
00010000	$2^4 = 16$
00100000	$2^5 = 32$
01000000	$2^6 = 64$
10000000	$2^7 = 128$



# Subnetting: Default Class A Netmask

## Class A Network

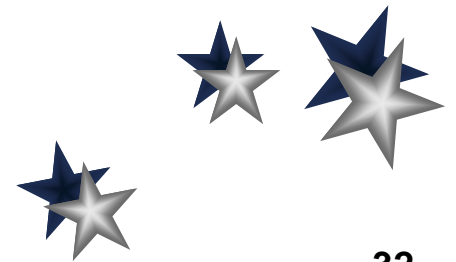
Default netmask = **255.0.0.0**

14.23.190.4



network  
portion

host  
portion



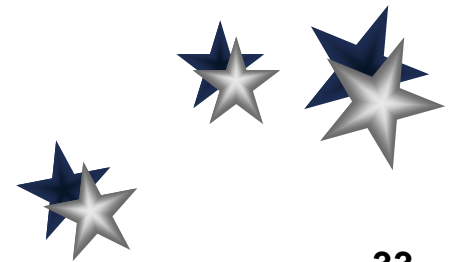
# Subnetting: Default Class B Netmask

## Class B Network

Default netmask = **255.255.0.0**



142.23.190.4  
network portion      host portion



# Subnetting: Default Class C Netmask

## Class C Network

Default netmask = **255.255.255.0**

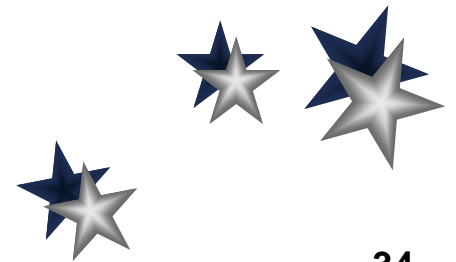


212.23.190.4



network  
portion

host  
portion

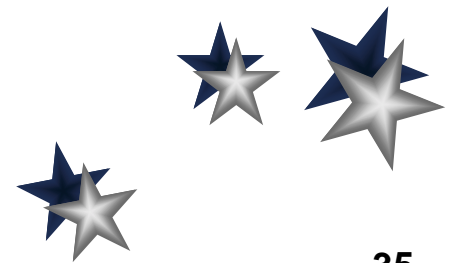


# Subnetting: Class C network with a subnet mask of 255.255.255.224

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- Subnets for a netmask are determined by working with the subnet field bits (those that extend into the node address portion of the IP address)
- The following example illustrates a node in a network with an IP address of 212.23.190.98 and a netmask of 255.255.255.224
- The subnet value field bits are 224





# Subnetting: Class C network with a subnet mask of 255.255.255.224

- Convert the 224 subnet field to binary

224 = 1 1 1 0 0 0 0 0



3 subnet field bits    5 node field bits



$$2^7 + 2^6 + 2^5 = 32 + 64 + 128 = 224$$

- The subnet field extends into the first three bits of the node portion of the IP address
- Five bits remain for the node portion



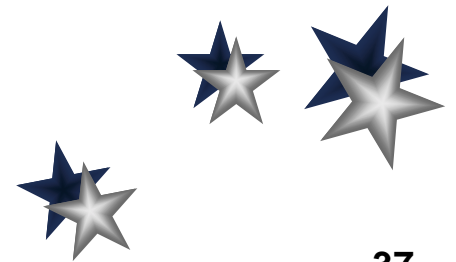
# Subnetting: Class C network with a subnet mask of 255.255.255.224

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**224 = 1 1 1 0 0 0 0 0**

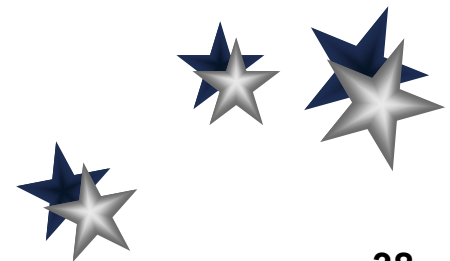
- All 0's or all 1's are not allowed for the subnet field
- All 0's for the node field is reserved for the subnet (network) address
- All 1's for the node field is reserved for the subnet (broadcast) address



# Subnetting: Class C network with a subnet mask of 255.255.255.224

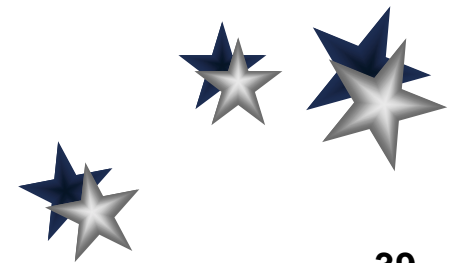
Subnet Field	Value	Subnet Address	Hosts IP Address	Broadcast Address
00000000	0	212.23.190.0	212.23.190.1 - 30	212.23.190.31
00100000	32	212.23.190.32	212.23.190.33 - 62	212.23.190.63
01000000	64	212.23.190.64	212.23.190.65 - 94	212.23.190.95
01100000	96	212.23.190.96	212.23.190.97 - 126	212.23.190.127
10000000	128	212.23.190.128	212.23.190.129 - 158	212.23.190.159
10100000	160	212.23.190.160	212.23.190.161 - 190	212.23.190.191
11000000	192	212.23.190.192	212.23.190.193 - 222	212.23.190.223
11100000	224	212.23.190.224	212.23.190.225 - 254	212.23.190.255

**Note: Values in red are not within the valid range**



# Subnetting: Class B network with a subnet mask of 255.255.192.0

- What are the range and values of the subnets for a node in a network with an IP address of 132.23.190.84 and a netmask of 255.255.192.0
- Let's begin by defining the subnet value field bits => 192



# Subnetting: Class B network with a subnet mask of 255.255.192.0

- Convert the 192 subnet field to binary

192 = 1 1 0 0 0 0 0 0



2 subnet field bits    6 node field bits

$$2^7 + 2^6 = 64 + 128 = 192$$

- The subnet field extends into the first two bits of the node portion of the IP address
- Six bits remain for the node portion

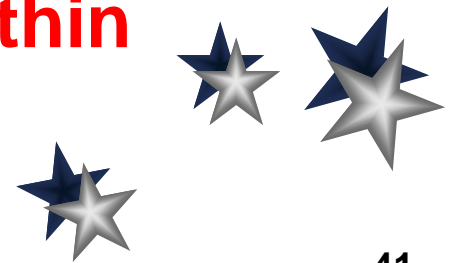


# Subnetting: Class B network with a subnet mask of 255.255.192.0

Subnet Field	Value	Subnet Address	Hosts IP Address	Broadcast Address
00000000	0			
01000000	64			
10000000	128			
11000000	192			

Let's just fill in the subnet field ...

**Remember: Values in red are not within the valid range**



# Subnetting: Class B network with a subnet mask of 255.255.192.0

Subnet Field	Value	Subnet Address	Hosts IP Address	Broadcast Address
00000000	0	132.23.0.0	132.23.0.1 - 132.23.63.254	132.23.63.255
01000000	64	132.23.64.0	132.23.64.1 - 132.23.127.254	132.23.127.255
10000000	128	132.23.128.0	132.23.128.1 - 132.23.191.254	132.23.191.255
11000000	192	132.23.192.0	132.23.192.1 - 132.23.255.254	132.23.255.255

Now, let's complete the subnet spreadsheet with the appropriate ranges and values

