

10.250.1.0  
192.168.10.96  
172.31.15.0

# VLSM

Variable-Length Subnet Mask

Workbook

Version 1.1

192.168.10.126

192.168.10.96

192.168.10.126

172.31.15.0

10.250.1.0

Student Name:

## IP Address Classes

Class A	1 – 127	(Network 127 is reserved for loopback and internal testing)	
	Leading bit pattern	0	00000000.00000000.00000000.00000000 Network . Host . Host . Host
Class B	128 – 191	Leading bit pattern	10
			10000000.00000000.00000000.00000000 Network . Network . Host . Host
Class C	192 – 223	Leading bit pattern	110
			11000000.00000000.00000000.00000000 Network . Network . Network . Host
Class D	224 – 239	(Reserved for multicast)	
Class E	240 – 255	(Reserved for experimental, used for research)	

## Private Address Space

Class A	10.0.0.0 to 10.255.255.255
Class B	172.16.0.0 to 172.31.255.255
Class C	192.168.0.0 to 192.168.255.255

## Default Subnet Masks

Class A	255.0.0.0
Class B	255.255.0.0
Class C	255.255.255.0

This workbook assumes you already have a background in subnetting. If you don't you may want to consider completing the [IP Addressing and Subnetting Workbook](#).

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Special Thanks to Melvin Baker and Jim Dorsch  
for taking the time to check this workbook for errors.

### Workbooks included in the series:

IP Addressing and Subnetting Workbooks  
ACLs - Access Lists Workbooks  
VLSM Variable-Length Subnet Mask IWorkbooks

# Classful vs. Classless Subnetting

When you're subnetting an IP address for a network you have two options: classful and classless. Classful subnetting is the simplest method. It tends to be the most wasteful because it uses more addresses than are necessary. In classful subnetting you use the same subnet mask for each subnet, and all the subnets have the same number of addresses in them.

Classless addressing allows you to use different subnet masks and create subnets tailored to the number of users in each group. This technique is referred to as VLSM.

## What is VLSM

Variable Length Subnet Masks allow you a much tighter control over your addressing scheme. If you use a class C address with a default subnet mask you end up with one subnet containing 256 addresses. By using VLSM you can adjust the number of subnets and number of addresses depending on the specific needs of your network. The same rules apply to a class A or B addresses.

VLSM is supported by the following protocols: RIP version 2, OSPF, EIGRP, Dual IS-IS, and BGP,. You need to configure your router for Variable Length Subnet Masking by setting up one of these protocols. Then configure the subnet masks of the various interfaces in the IP address interface sub-command.

## Benefits of VLSM

- Allows efficient use of address space
- Allows the use of multiple subnet mask lengths
- Breaks up an address block into smaller custom blocks
- Allows for route summarization
- Provides more flexibility in network design
- Supports hierarchical enterprise networks

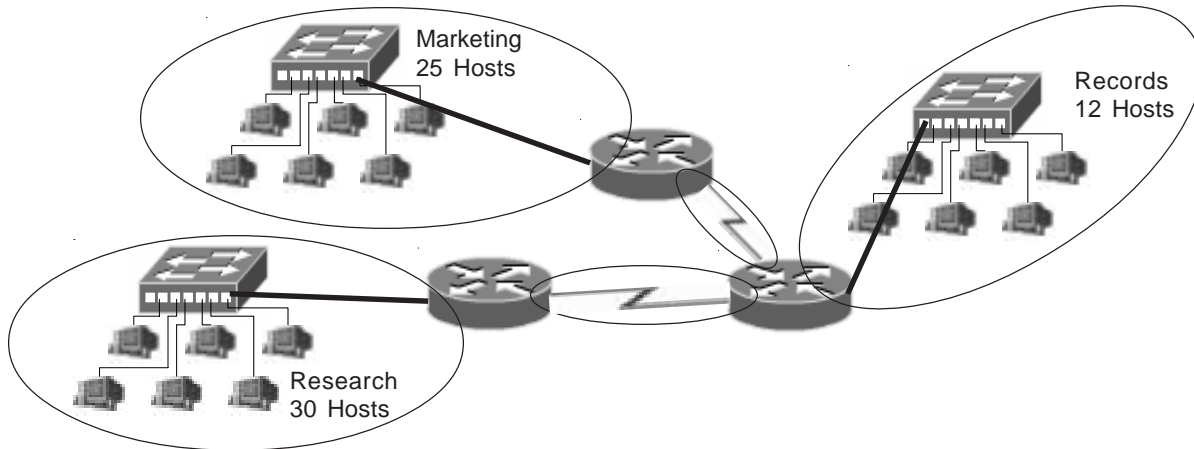
This workbook explores three different methods to figure out sub-subnets: the box method, the circle method, and a VLSM chart.

# Classful Subnetting Example

When you're subnetting an IP address for a network you have two options: classful and classless. Classful subnetting is the simplest method. It also tends to be the most wasteful because it uses more addresses than are necessary. In classful subnetting you use the same subnet mask for each subnet, and all the subnets have the same number of addresses in them.

In this example you need five subnets, each one containing 30 hosts. The serial connections only require two address each so you are wasting 28 usable addresses in each of the serial subnet ranges.

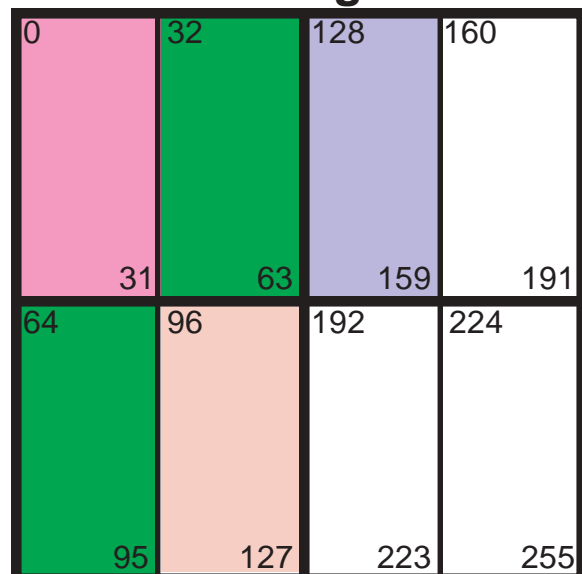
## IP Address: 192.168.1.0



## The Box Method for visualizing subnets

### Classful Subnet Ranges

192.168.1.0	to	192.168.1.31	/27
192.168.1.32	to	192.168.1.63	/27
192.168.1.64	to	192.168.1.95	/27
192.168.1.96	to	192.168.1.127	/27
192.168.1.128	to	192.168.1.159	/27
192.168.1.160	to	192.168.1.191	/27
192.168.1.192	to	192.168.1.223	/27
192.168.1.224	to	192.168.1.255	/27
			/27
		255.255.255.224	
		32 Hosts	
		8 Subnets	

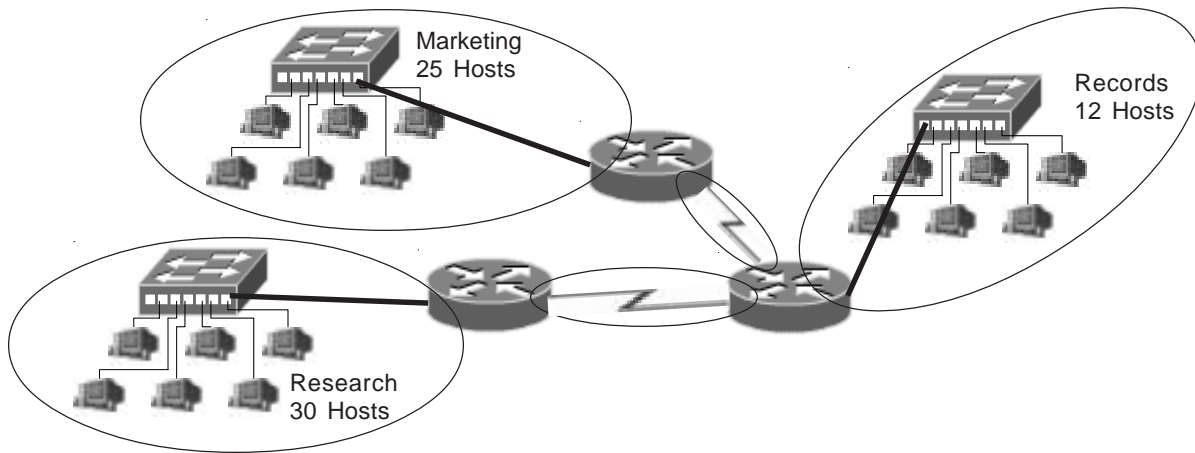


# Classless Subnetting Example

Classless addressing allows you to use different subnet masks and create subnets tailored to the number of users in each subnetwork. There are fewer wasted IP addresses using smaller subnets.

In this example you need a total of five subnets, two containing 30 hosts, one containing 12 hosts, and two serial connections that only require two addresses each.

## IP Address: 192.168.1.0

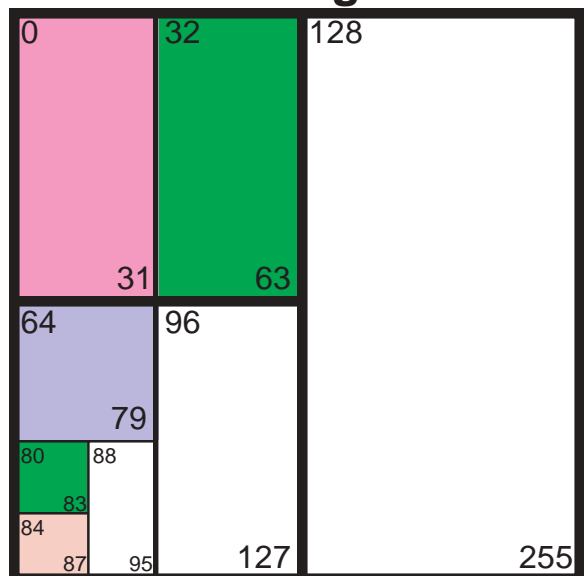


By adjusting the subnet masks you can cut your address usage by almost half in this example. This type of subnetting requires a network protocol which will support it such as: RIP version 2, EIGRP, OSPF, or BGP.

## The Box Method for visualizing subnets

### Classless Subnet Ranges

192.168.1.0	to	192.168.1.31	/27
192.168.1.32	to	192.168.1.63	/27
192.168.1.64	to	192.168.1.79	/28
192.168.1.80	to	192.168.1.82	/30
192.168.1.84	to	192.168.1.87	/30
192.168.1.88	to	192.168.1.95	/29
192.168.1.96	to	192.168.1.127	/27
192.168.1.128	to	192.168.1.255	/25

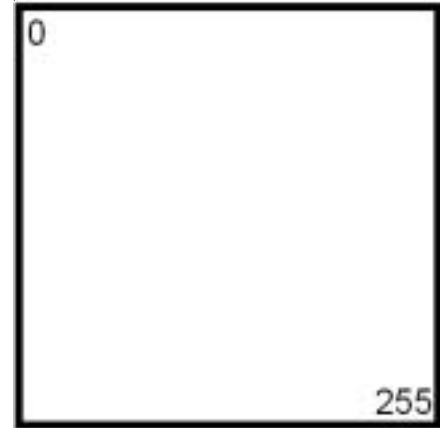


# Visualizing Subnets Using The Box Method

The box method is a simple way to visualize the breakdown of subnets and addresses into smaller sizes. By shading or coloring in the boxes you can easily break up your subnets without overlapping your addresses. You adjust each subnet to the correct size needed.

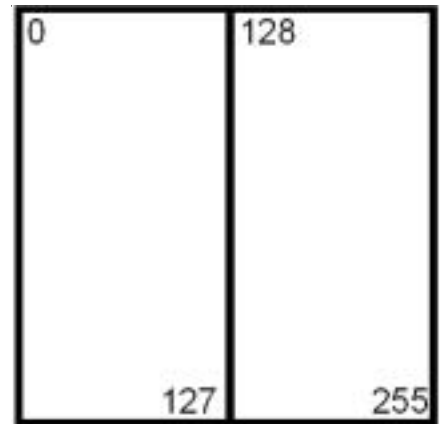
Start with a square. The whole square is a single subnet comprised of 256 addresses.

/24  
255.255.255.0  
256 Hosts  
1 Subnet



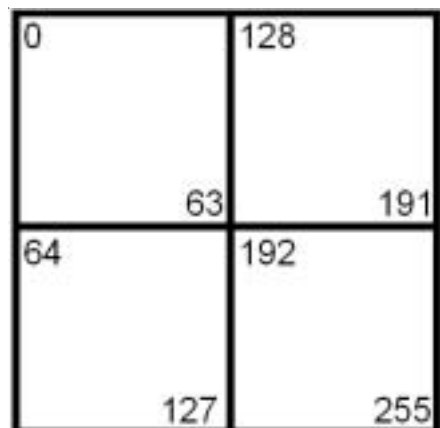
Split the box in half and you get two subnets with 128 addresses.

/25  
255.255.255.128  
128 Hosts  
2 Subnets



Divide the box into quarters and you get four subnets with 64 addresses.

/26  
255.255.255.192  
64 Hosts  
4 Subnets



Split each individual square and you get eight subnets with 32 addresses.

*/27*  
**255.255.255.224**  
**32 Hosts**  
**8 Subnets**

0	32	128	160
31	63	159	191
64	96	192	224
95	127	223	255

Split the boxes in half again and you get sixteen subnets with sixteen addresses.

*/28*  
**255.255.255.240**  
**16 Hosts**  
**16 Subnets**

0	32	128	160
15	47	143	175
16	48	144	176
31	63	159	191
64	96	192	224
79	111	207	239
80	112	208	240
95	127	223	255

The next split gives you thirty two subnets with eight addresses.

*/29*  
**255.255.255.248**  
**8 Hosts**  
**32 Subnets**

0	8	32	40	128	136	160	168
7	15	39	47	135	143	167	175
16	24	48	56	144	152	176	184
23	31	55	63	151	159	183	191
64	72	96	104	192	200	224	232
71	79	103	111	199	207	231	239
80	88	112	120	208	216	240	248
87	95	119	127	215	223	247	255

The last split gives sixty four subnets with four addresses each.

*/30*  
**255.255.255.252**  
**4 Hosts**  
**64 Subnets**

0	8	32	40	128	136	160	168
3	11	35	43	131	139	163	171
4	12	36	44	132	140	164	172
7	15	39	47	135	143	167	175
16	24	48	56	144	152	176	184
19	27	51	59	147	155	179	187
20	28	52	60	148	156	180	188
23	31	55	63	151	159	183	191
64	72	96	104	192	200	224	232
67	75	99	107	195	203	227	235
68	76	100	108	196	204	228	236
71	79	103	111	199	207	231	239
80	88	112	120	208	216	240	248
83	91	115	123	211	219	243	251
84	92	116	124	212	220	244	252
87	95	119	127	215	223	247	255

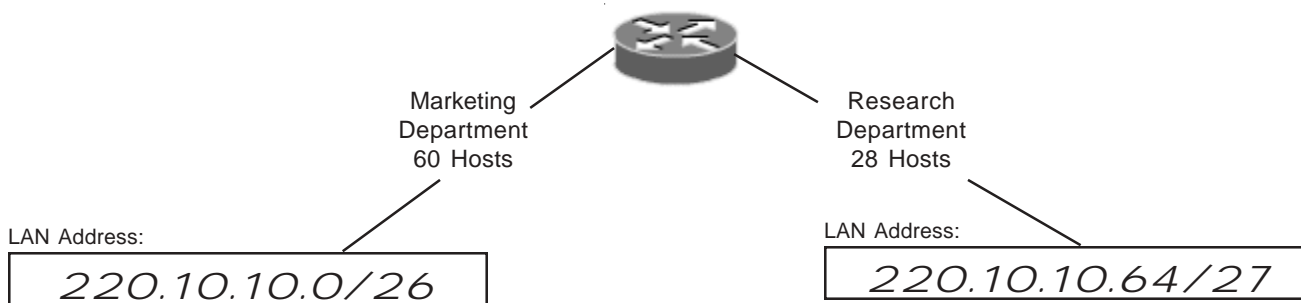
# VLSM Addressing

## Box Method

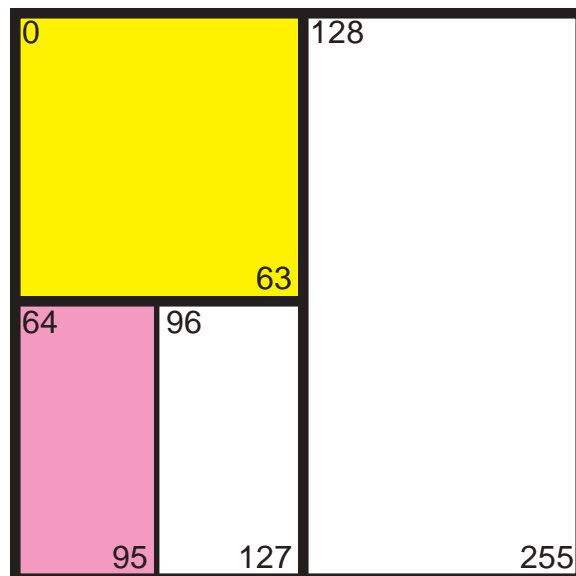
(Sample)

### Problem 1

Using the network diagram and information given create an addressing scheme which utilizes variable-length subnet masks. Show the subnet address and CIDR in the boxes below, color or shade the sub-subnets used in the box. This business will be using the class C address 220.10.10.0. Remember to start with your largest groups first.



Color in the squares used with different shades to highlight each subnet.





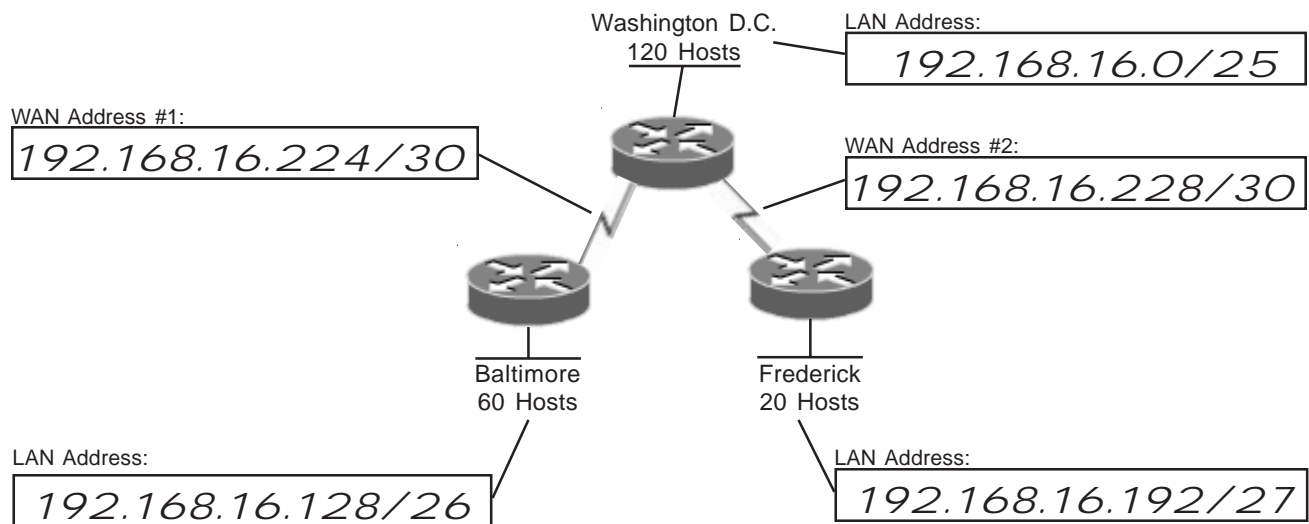
# VLSM Addressing

## Box Method

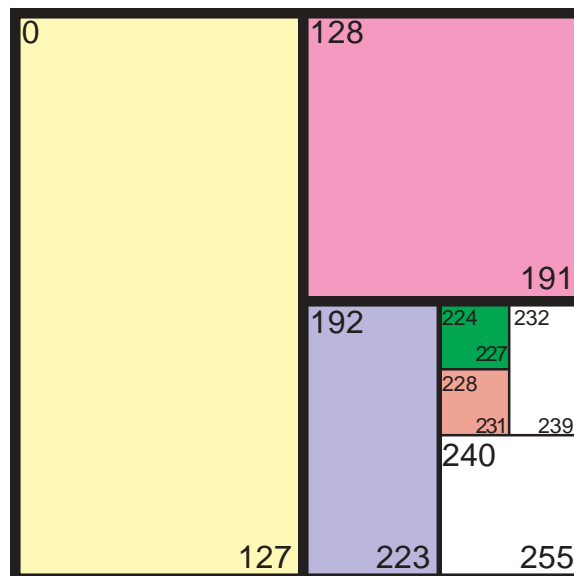
(Sample)

### Problem 2

Using the network diagram and information given create an addressing scheme which utilizes variable-length subnet masks. Show the subnet address and CIDR in the boxes below, color or shade the sub-subnets used in the box. This company will be using the class C address 192.168.16.0. Remember to start with your largest groups first.



Color in the squares used with different shades to highlight each subnet.

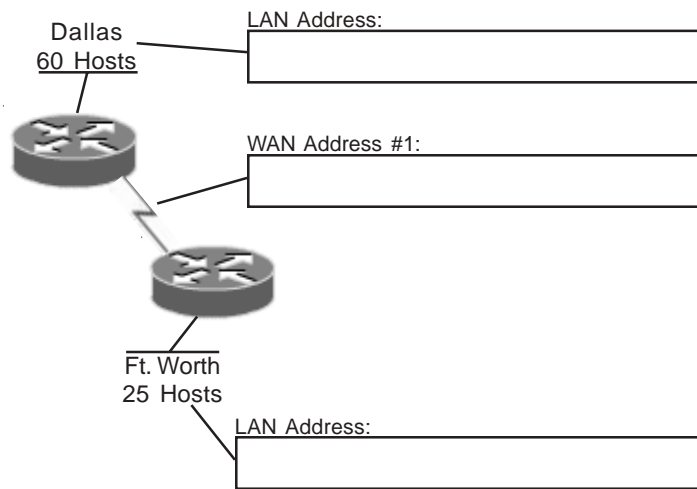


# VLSM Addressing

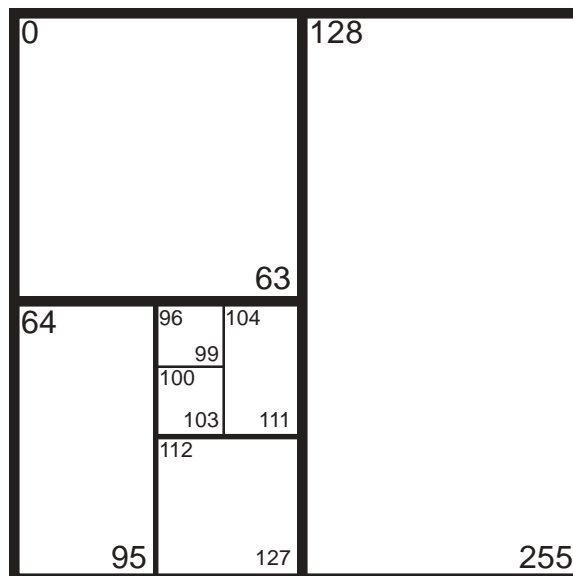
## Box Method

### Problem 3

Using the network diagram and information given create an addressing scheme which utilizes variable-length subnet masks. Show the subnet address and CIDR in the boxes below, color or shade the sub-subnets used in the box. This company will be using the class C address 190.10.10.0. Remember to start with your largest groups first.



Color in the squares used with different shades to highlight each subnet.

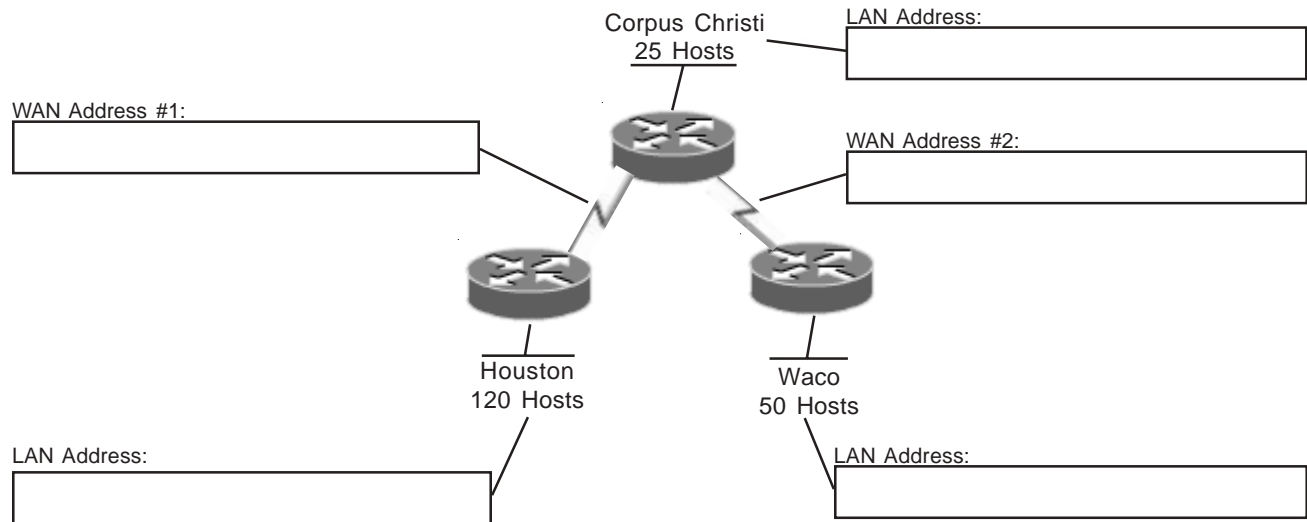


# VLSM Addressing

## Box Method

### Problem 4

Using the network diagram and information given create an addressing scheme which utilizes variable-length subnet masks. Show the subnet address and CIDR in the boxes below, color or shade the sub-subnets used in the box. This company will be using the class C address 220.108.38.0. Remember to start with your largest groups first.



Color in the squares used with different shades to highlight each subnet.

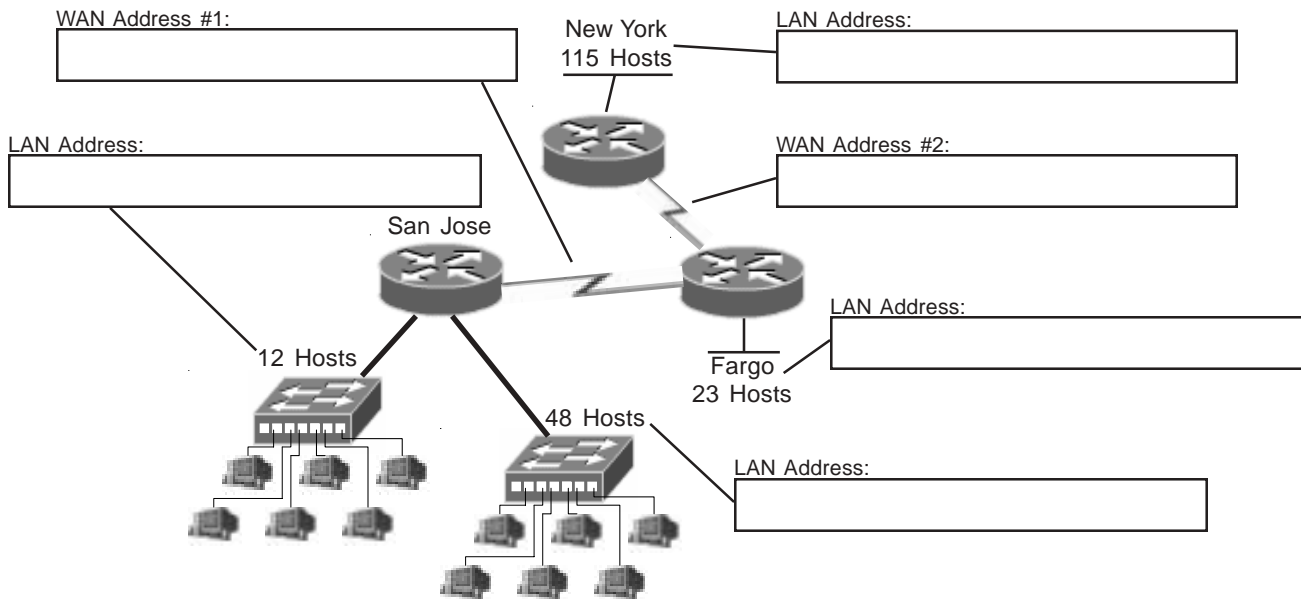
0	8	32	40	128	136	160	168	
	3	11	35	43	131	139	163	171
4	12	36	44	132	140	164	172	
	7	15	39	47	135	143	167	175
16	24	48	56	144	152	176	184	
	19	27	51	59	147	155	179	187
20	28	52	60	148	156	180	188	
	23	31	55	63	151	159	183	191
64	72	96	104	192	200	224	232	
	67	75	99	107	195	203	227	235
68	76	100	108	196	204	228	236	
	71	79	103	111	199	207	231	239
80	88	112	120	208	216	240	248	
	83	91	115	123	211	219	243	251
84	92	116	124	212	220	244	252	
	87	95	119	127	215	223	247	255

# VLSM Addressing

## Box Method

### Problem 5

Using the network diagram and information given create an addressing scheme which utilizes variable-length subnet masks. Show the subnet address and CIDR in the boxes below, color or shade the sub-subnets used in the box. This company will be using the class C address 192.168.10.0. Remember to start with your largest groups first.



Color in the squares used with different shades to highlight each subnet.

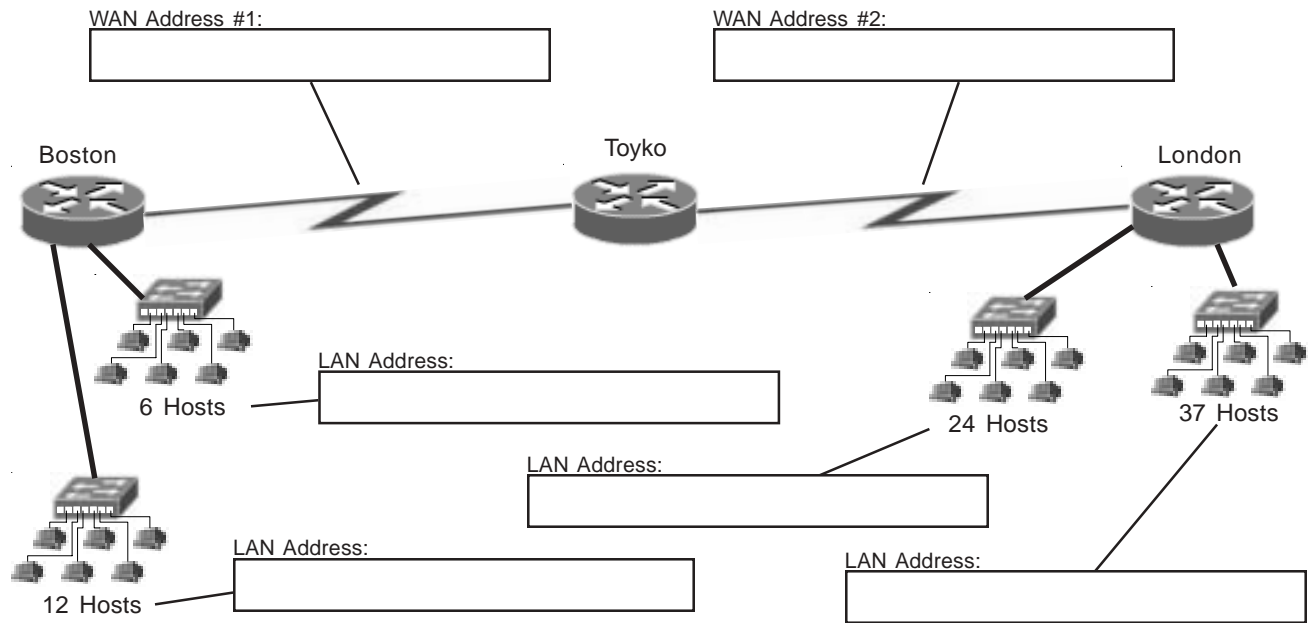
0	8	32	40	128	136	160	168	
	3	11	35	43	131	139	163	171
4	12	36	44	132	140	164	172	
	7	15	39	47	135	143	167	175
16	24	48	56	144	152	176	184	
	19	27	51	59	147	155	179	187
20	28	52	60	148	156	180	188	
	23	31	55	63	151	159	183	191
64	72	96	104	192	200	224	232	
	67	75	99	107	195	203	227	235
68	76	100	108	196	204	228	236	
	71	79	103	111	199	207	231	239
80	88	112	120	208	216	240	248	
	83	91	115	123	211	219	243	251
84	92	116	124	212	220	244	252	
	87	95	119	127	215	223	247	255

# VLSM Addressing

## Box Method

### Problem 6

Using the network diagram and information given create an addressing scheme which utilizes variable-length subnet masks. Show the subnet address and CIDR in the boxes below, color or shade the sub-subnets used in the box. This company will be using the class C address 222.10.150.0. Remember to start with your largest groups first.



Draw the necessary lines and color in the used squares with different shades to highlight each subnet.

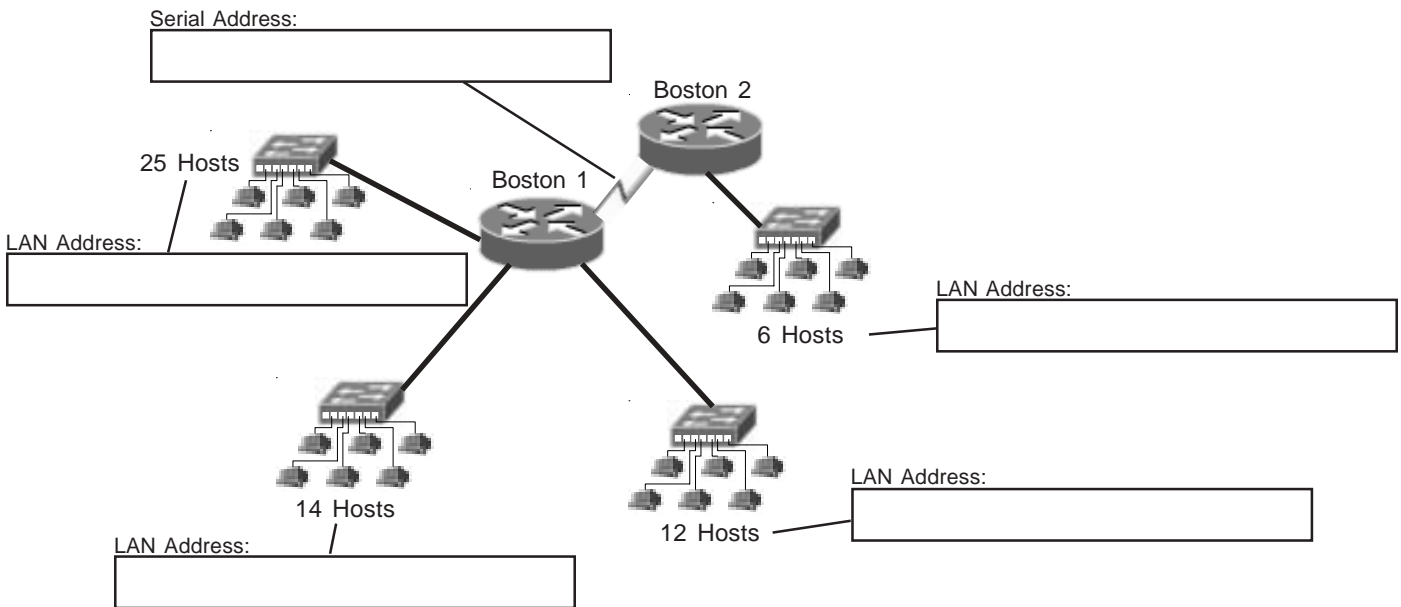
0	32	128	160
	31	63	159
64	96	192	224
	95	127	255

# VLSM Addressing

## Box Method

### Problem 7

Using the network diagram and information given create an addressing scheme which utilizes variable-length subnet masks. Show the subnet address and subnet mask in the boxes below, color or shade the sub-subnets used in the box. This company will be using the class C address 200.150.70.0. Remember to start with your largest groups first.



Draw the necessary lines and color in the used squares with different shades to highlight each subnet.

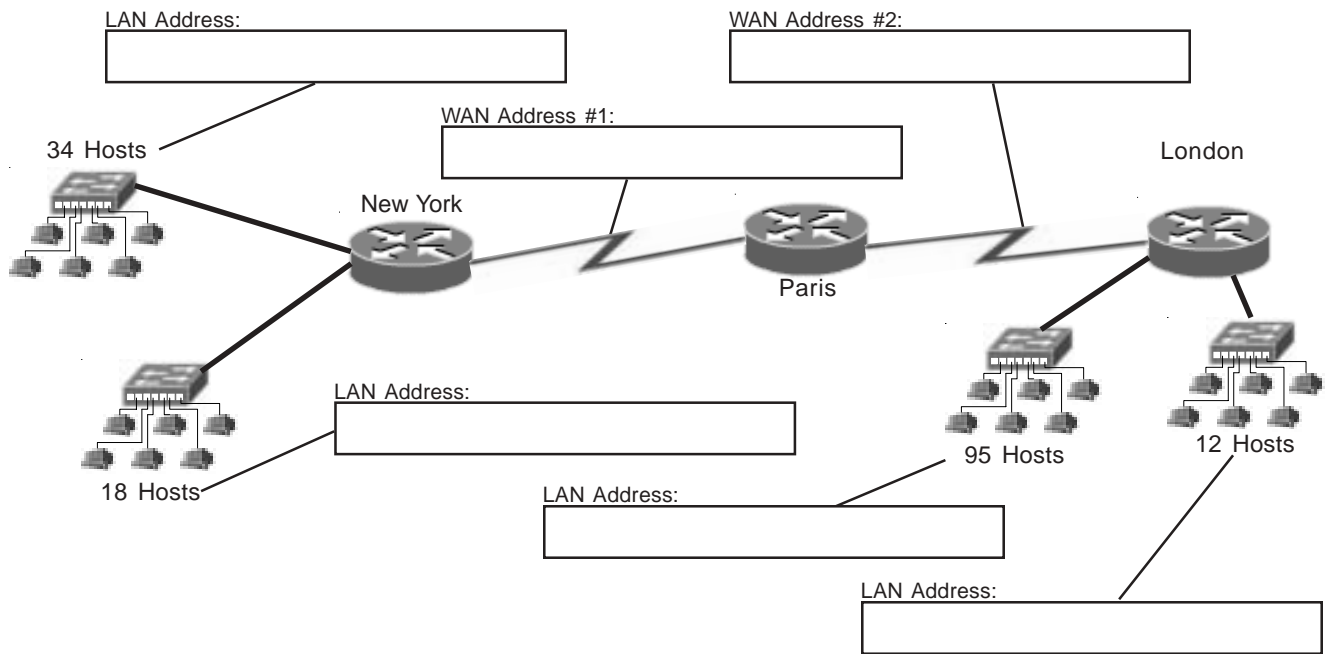
0	128
63	191
64	192
127	255

# VLSM Addressing

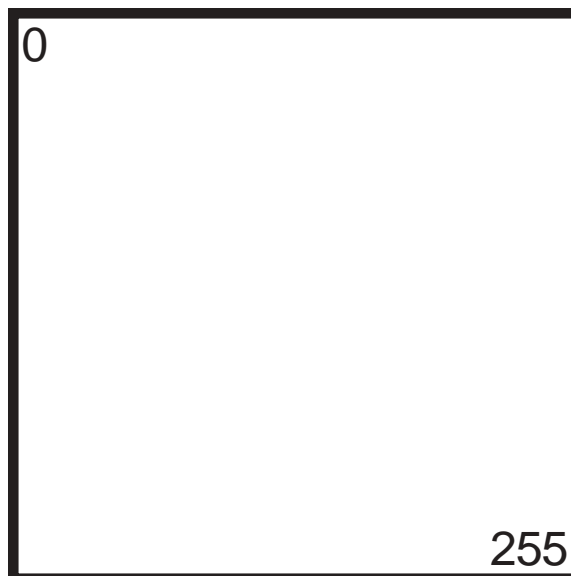
## Box Method

### Problem 8

Using the network diagram and information given create an addressing scheme which utilizes variable-length subnet masks. Show the subnet address and subnet mask in the boxes below, color or shade the sub-subnets used in the box. This company will be using the class C address 192.168.24.0. Remember to start with your largest groups first.



Draw the necessary lines and color in the used squares with different shades to highlight each subnet.

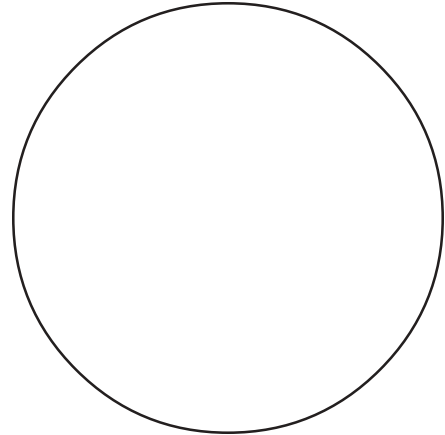


# Visualizing Subnets Using The Circle Method

The circle method is another method used to visualize the breakdown of subnets and addresses into smaller sizes. By shading or coloring in the different sections of the circle you can easily break up your subnets without overlapping your addresses. You adjust each subnet to the correct size needed.

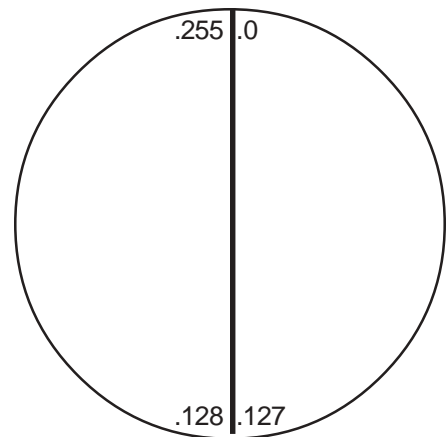
Start with a circle. The whole circle is a single subnet comprised of 256 addresses.

**/24**  
**255.255.255.0**  
**256 Hosts**  
**1 Subnet**



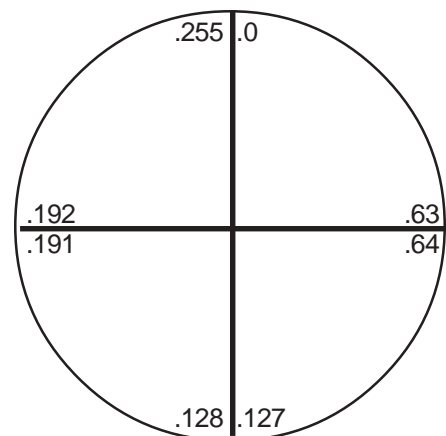
Split the circle in half and you get two subnets with 128 addresses.

**/25**  
**255.255.255.128**  
**128 Hosts**  
**2 Subnets**



Divide the circle into quarters and you get four subnets with 64 addresses.

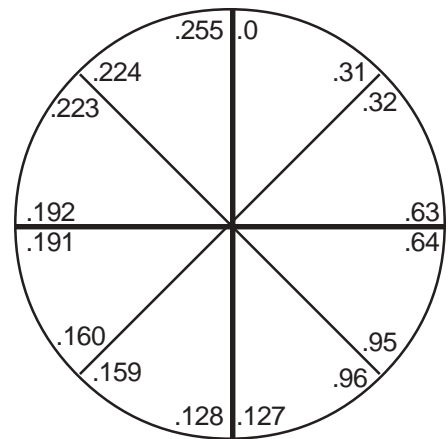
**/26**  
**255.255.255.192**  
**64 Hosts**  
**4 Subnets**





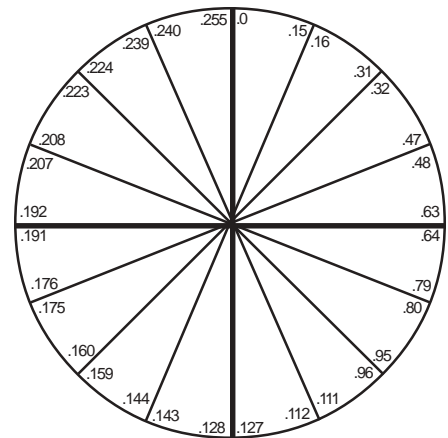
Split each quarter and you get eight subnets with 32 addresses.

**/27**  
**255.255.255.224**  
**32 Hosts**  
**8 Subnets**



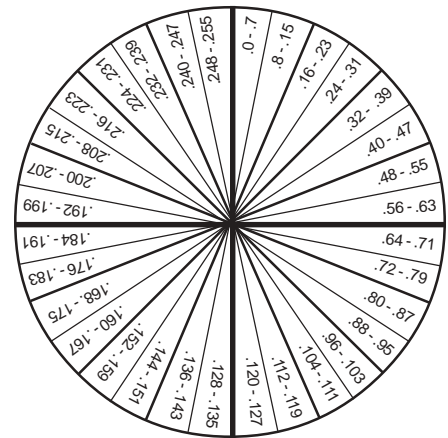
Split the boxes in half again and you get sixteen subnets with sixteen addresses.

**/28**  
**255.255.255.240**  
**16 Hosts**  
**16 Subnets**



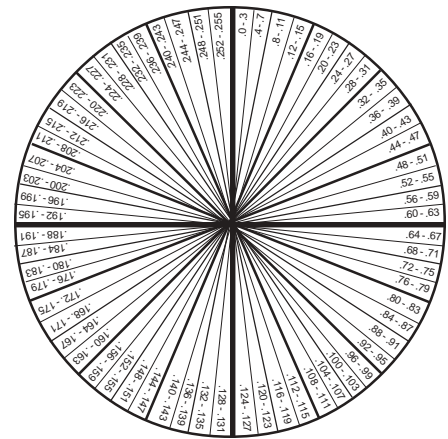
The next split gives you thirty two subnets with eight addresses.

**/29**  
**255.255.255.248**  
**8 Hosts**  
**32 Subnets**



The last split gives sixty four subnets with four addresses each.

**/30**  
**255.255.255.252**  
**4 Hosts**  
**64 Subnets**



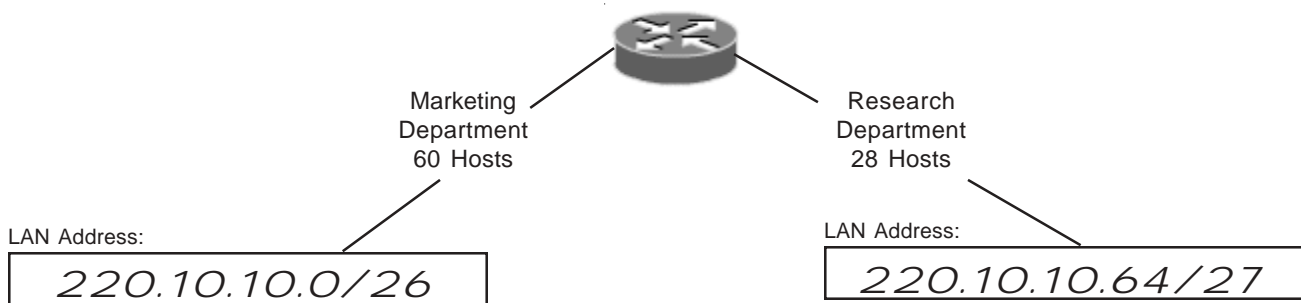
# VLSM Addressing

## Circle Method

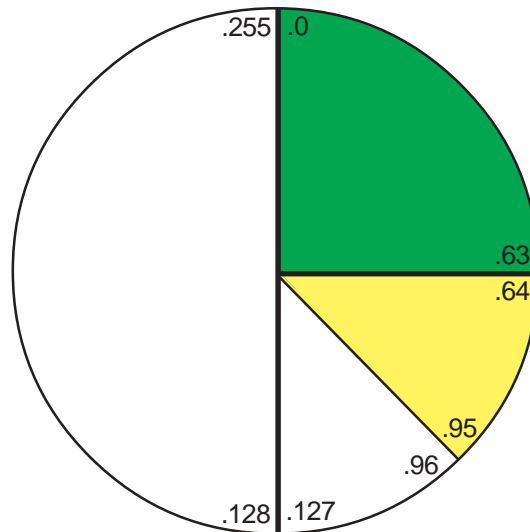
(Sample)

### Problem 9

Using the network diagram and information given create an addressing scheme which utilizes variable-length subnet masks. Show the subnet address and CIDR in the circle below, color or shade the sub-subnets used. This business will be using the class C address 220.10.10.0. Remember to start with your largest groups first.



Color in the necessary circle sections used with different shades to highlight each subnet.



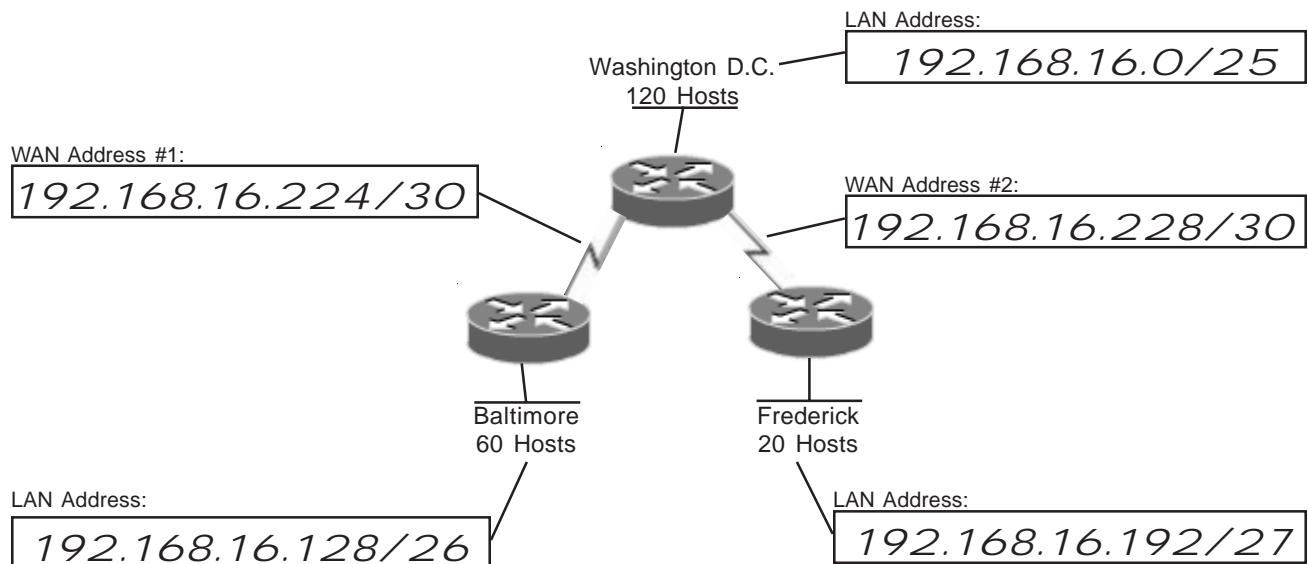
# VLSM Addressing

## Circle Method

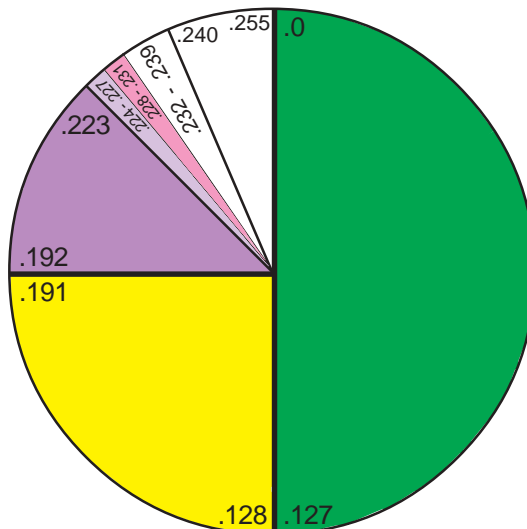
(Sample)

### Problem 10

Using the network diagram and information given create an addressing scheme which utilizes variable-length subnet masks. Show the subnet address and CIDR in the circle below, color or shade the sub-subnets used. This company will be using the class C address 192.168.16.0. Remember to start with your largest groups first.



Color in the necessary circle sections used with different shades to highlight each subnet.

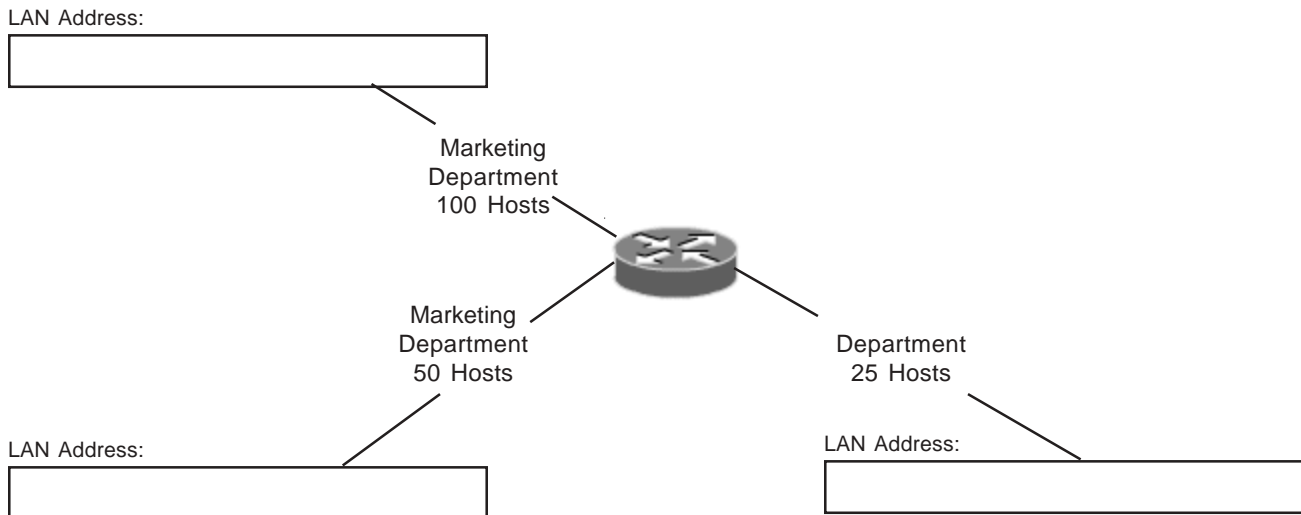


# VLSM Addressing

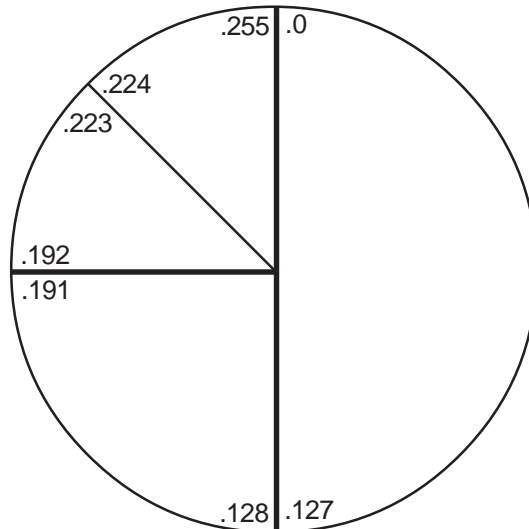
## Circle Method

### Problem 11

Using the network diagram and information given create an addressing scheme which utilizes variable-length subnet masks. Show the subnet address and CIDR in the circle below, color or shade the sub-subnets used. This business will be using the class C address 200.20.20.0. Remember to start with your largest groups first.



Color in the necessary circle sections used with different shades to highlight each subnet.

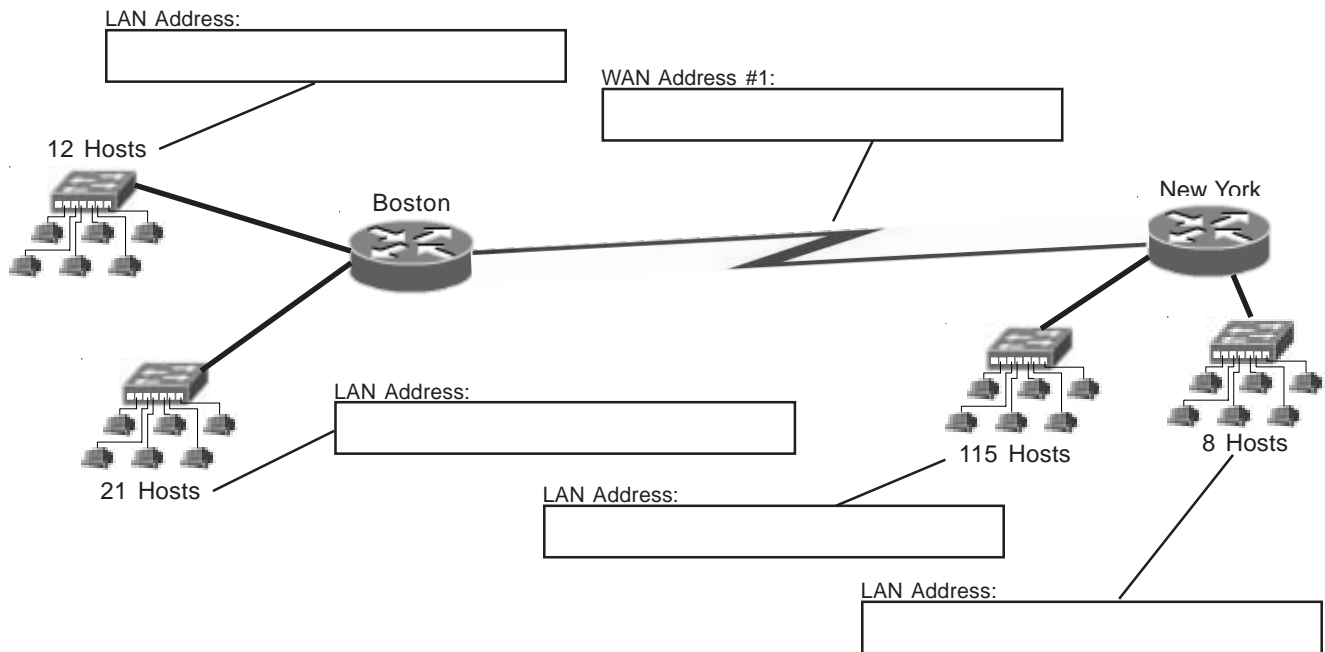


# VLSM Addressing

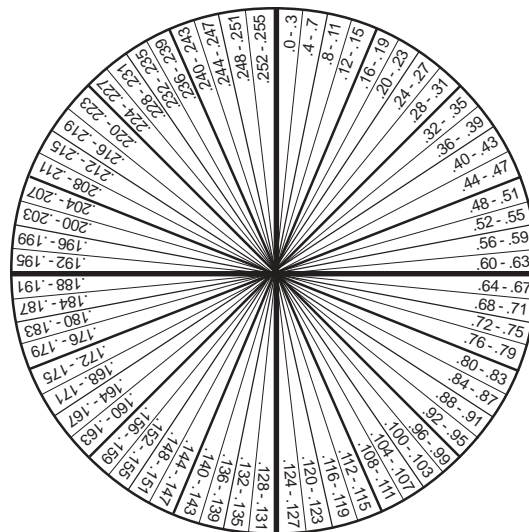
## Circle Method

### Problem 12

Using the network diagram and information given create an addressing scheme which utilizes variable-length subnet masks. Show the subnet address and CIDR in the circle below, color or shade the sub-subnets used. This company will be using the class C address 199.55.70.0. Remember to start with your largest groups first.



Color in the necessary circle sections used with different shades to highlight each subnet.

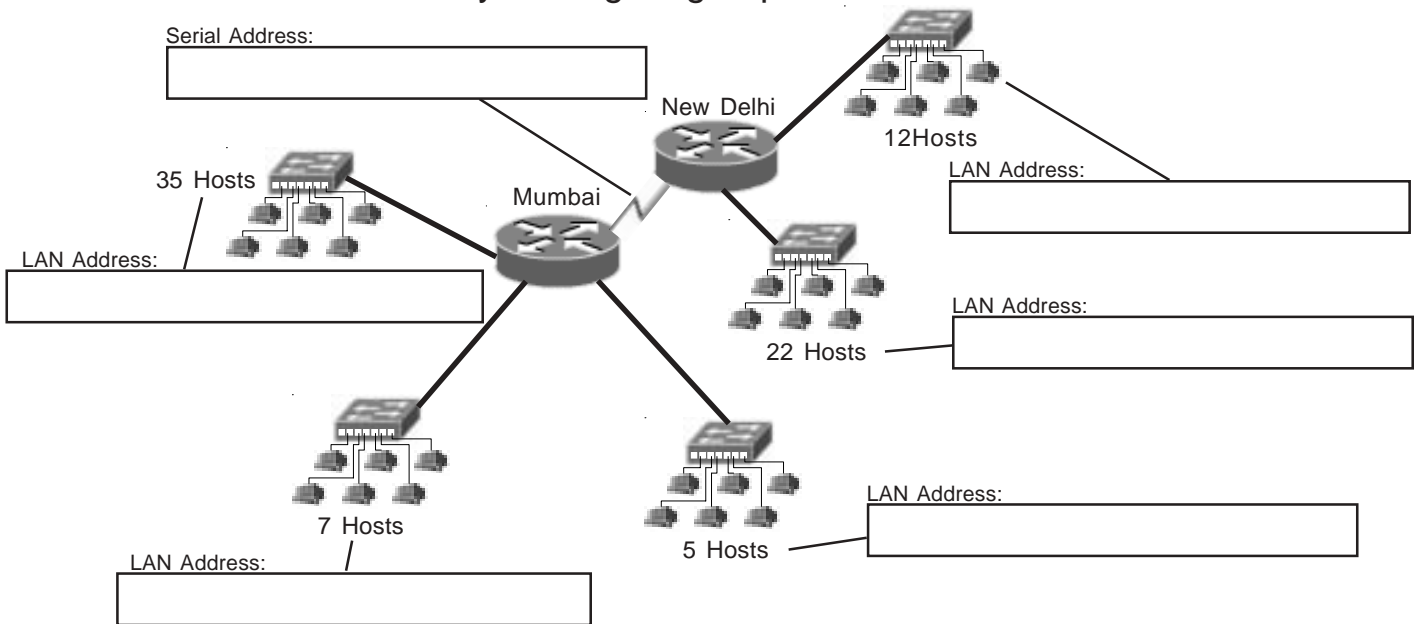


# VLSM Addressing

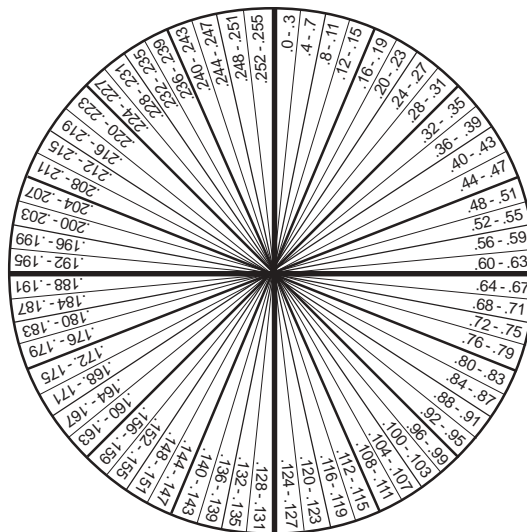
## Circle Method

### Problem 13

Using the network diagram and information given create an addressing scheme which utilizes variable-length subnet masks. Show the subnet address and CIDR in the circle below, color or shade the sub-subnets used. This company will be using the class C address 200.150.70.0. Remember to start with your largest groups first.



Color in the necessary circle sections used with different shades to highlight each subnet.

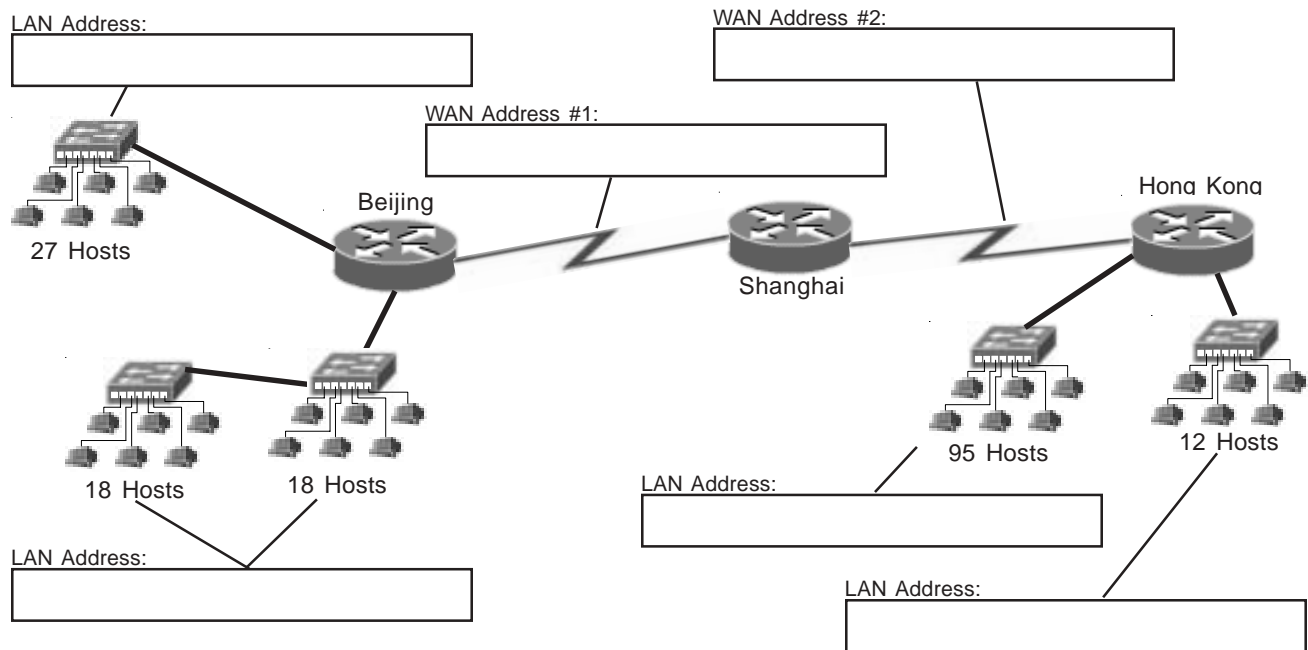


# VLSM Addressing

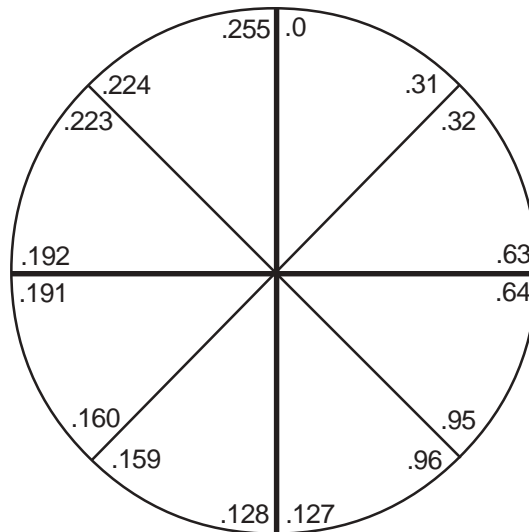
## Circle Method

### Problem 14

Using the network diagram and information given create an addressing scheme which utilizes variable-length subnet masks. Show the subnet address and CIDR in the circle below, color or shade the sub-subnets used. This company will be using the class C address 210.10.10.0. Remember to start with your largest groups first.



Draw the necessary lines and color in the used circle sections with different shades to highlight each subnet.

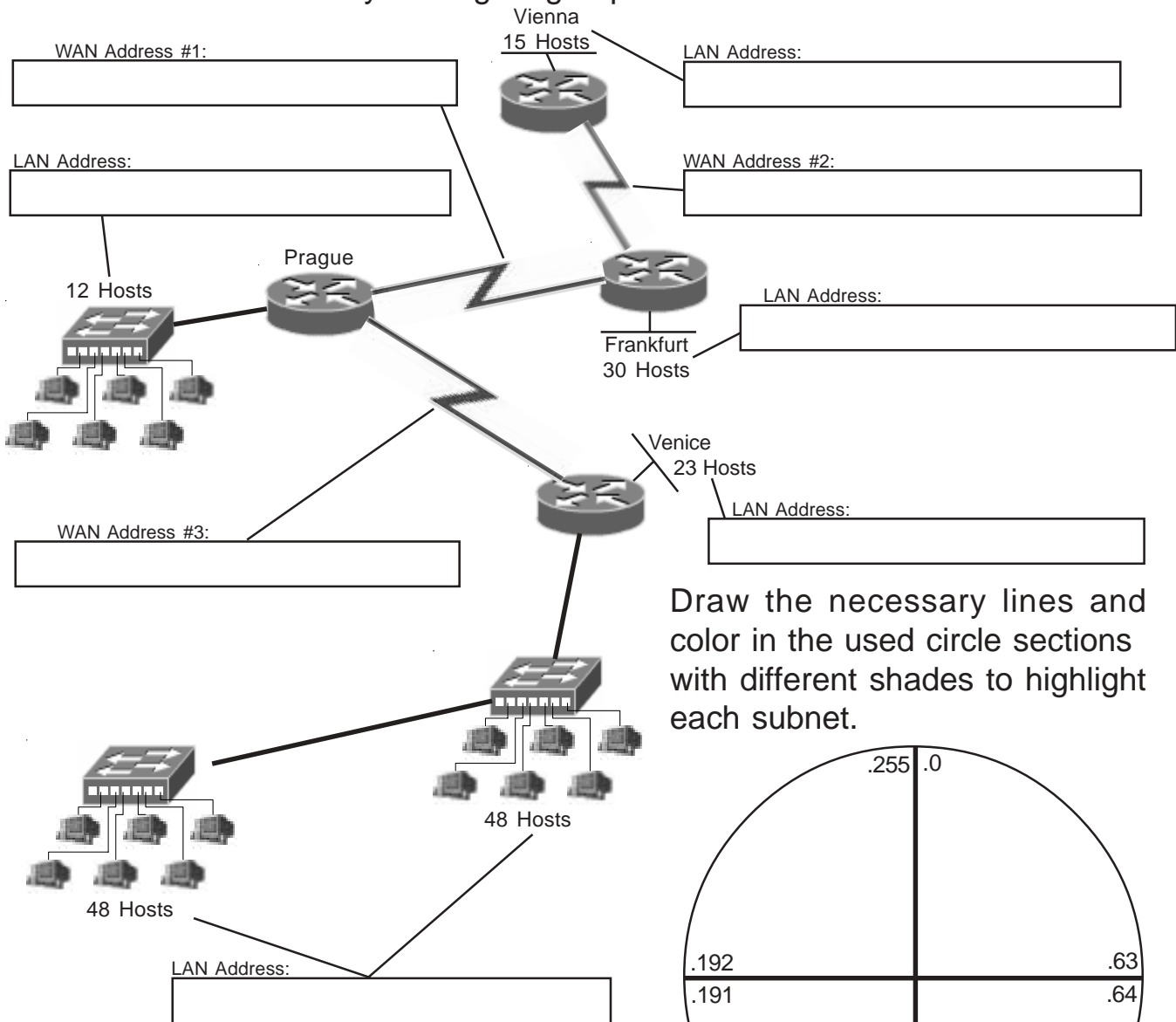


# VLSM Addressing

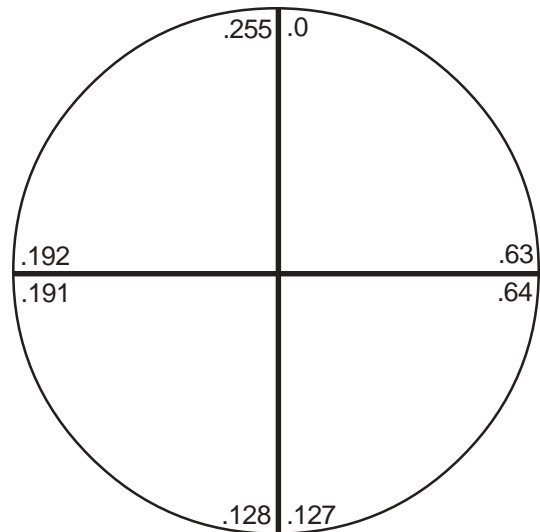
## Circle Method

### Problem 15

Using the network diagram and information given create an addressing scheme which utilizes variable-length subnet masks. Show the subnet address and CIDR in the boxes below, color or shade the sub-subnets used in the circle. This company will be using the class C address 192.168.150.0. Remember to start with your largest groups first.



Draw the necessary lines and color in the used circle sections with different shades to highlight each subnet.



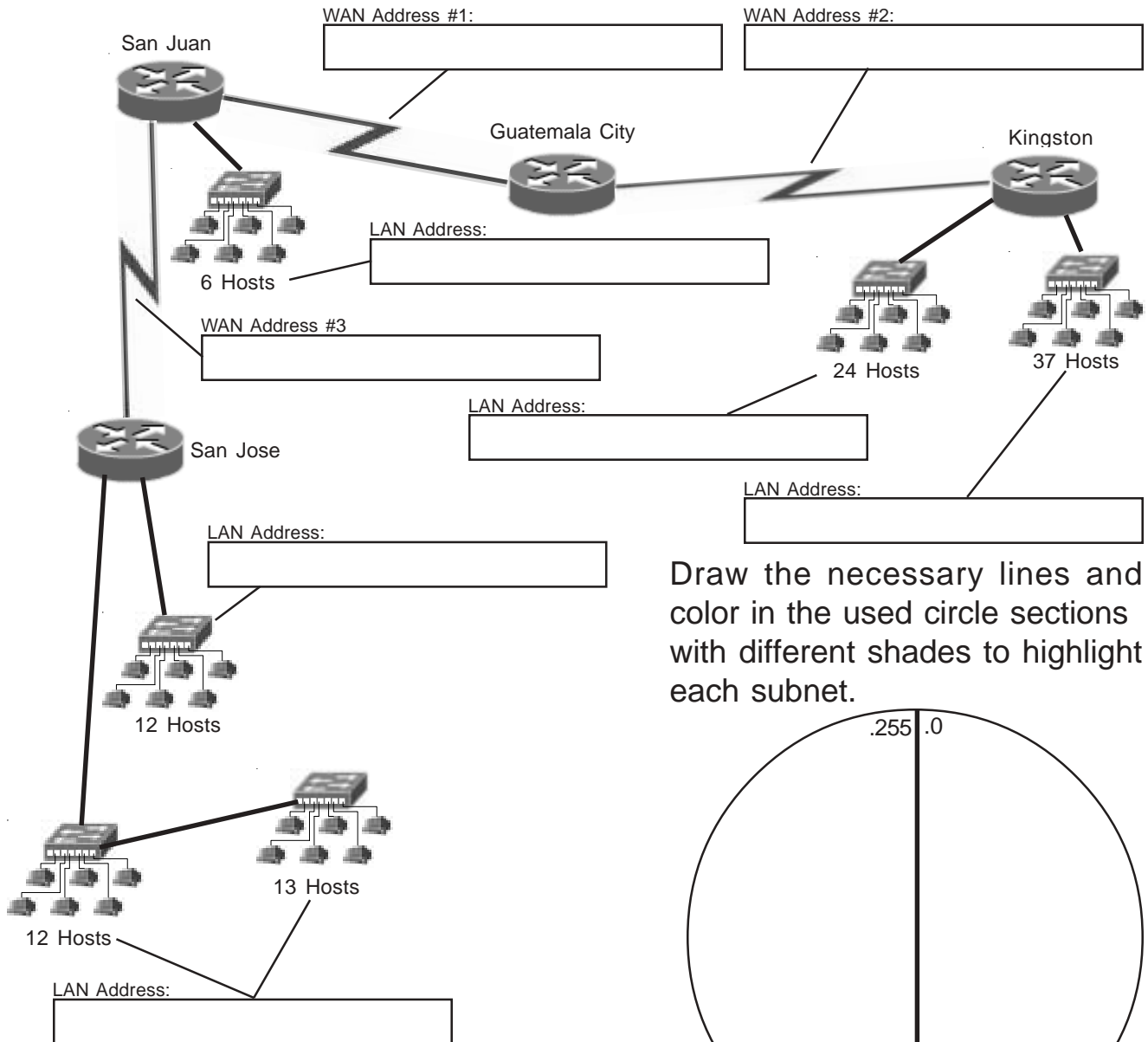


# VLSM Addressing

## Circle Method

### Problem 16

Using the network diagram and information given create an addressing scheme which utilizes variable-length subnet masks. Show the subnet address and CIDR in the boxes below, color or shade the sub-subnets used in the circle. This company will be using the class C address 195.75.23.0. Remember to start with your largest groups first.



# Visualizing Subnets Using a VLSM Chart

The VLSM chart is the third method used to visualize the breakdown of subnets and addresses into smaller sizes. By shading or coloring in the boxes you can easily break up your subnets without overlapping your addresses. You can adjust each sub-subnet to the correct size needed.

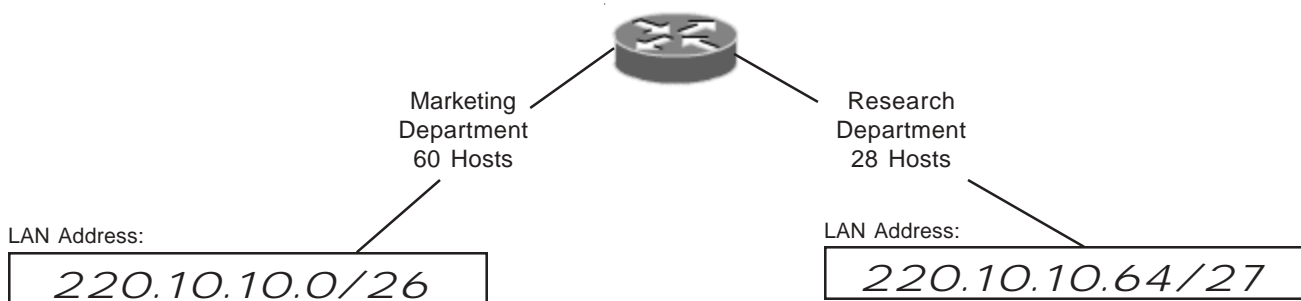
## VLSM Addressing

### VLSM Chart Method

(Sample)

### Problem 17

Using the network diagram and information given create an addressing scheme which utilizes variable-length subnet masks. Show the subnet address and CIDR in the boxes below, color or shade the sub-subnets used in the chart. This business will be using the class C address 220.10.10.0. Remember to start with your largest groups first.



# Class C Addresses

## VLSM Chart 24-30 Bits (4th octet)

<b>/24</b> 255.255.255.0 256 Hosts	<b>/25</b> 255.255.255.128 128 Hosts	<b>/26</b> 255.255.255.192 64 Hosts	<b>/27</b> 255.255.255.224 32 Hosts	<b>/28</b> 255.255.255.240 16 Hosts	<b>/29</b> 255.255.255.248 8 Hosts	<b>/30</b> 255.255.255.252 4 Hosts
0 - 255	0-127	0-63	0-31	0-15	0-7	0-3
					4-7	4-7
				8-15	8-11	
				12-15	12-15	
			16-31	16-23	16-19	
				20-23	20-23	
				24-31	24-27	
				28-31	28-31	
		32-63	32-47	32-39	32-35	
				36-39	36-39	
				40-47	40-43	
				44-47	44-47	
			48-63	48-55	48-51	
				52-55	52-55	
				56-63	56-59	
				60-63	60-63	
	64-127	64-95	64-79	64-71	64-67	
				68-71	68-71	
				72-79	72-75	
				76-79	76-79	
			80-95	80-83	80-83	
				84-87	84-87	
				88-95	88-91	
				92-95	92-95	
		96-127	96-111	96-103	96-99	
				100-103	100-103	
				104-111	104-107	
				108-111	108-111	
			112-127	112-119	112-115	
				116-119	116-119	
				120-127	120-123	
				124-127	124-127	
128-255	128-191	128-159	128-143	128-131		
			132-135	132-135		
			136-143	136-139		
			140-143	140-143		
		144-159	144-151	144-147		
			148-151	148-151		
			152-159	152-155		
			156-159	156-159		
	160-191	160-175	16-167	160-163		
			164-167	164-167		
			168-175	168-171		
			172-175	172-175		
		176-191	176-183	176-179		
			180-183	180-183		
			184-191	184-187		
			188-191	188-191		
192-255	192-223	192-207	192-195			
		196-199	196-199			
		200-207	200-203			
		204-207	204-207			
	208-223	208-215	208-211			
		212-215	212-215			
		216-223	216-219			
		220-223	220-223			
224-255	224-239	224-231	224-227			
		228-231	228-231			
		232-235	232-235			
		236-239	236-239			
	240-255	240-247	240-243			
		244-247	244-247			
		248-251	248-251			
		252-255	252-255			

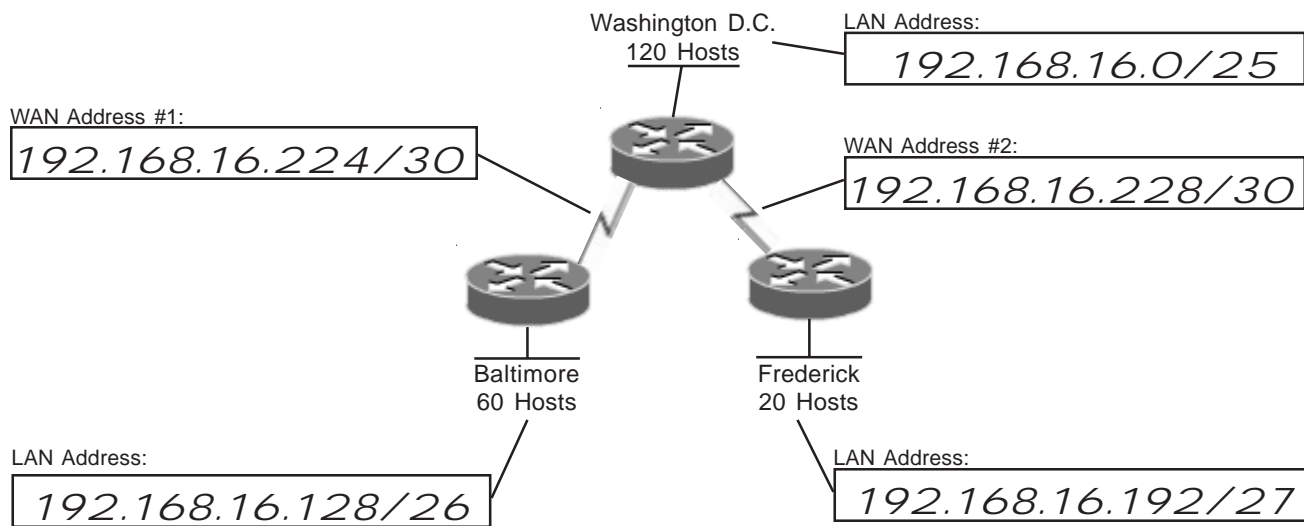
# VLSM Addressing

## VLSM Chart Method

(Sample)

### Problem 18

Using the network diagram and information given create an addressing scheme which utilizes variable-length subnet masks. Show the subnet address and CIDR in the boxes below, color or shade the sub-subnets used in the chart. This company will be using the class C address 192.168.16.0. Remember to start with your largest groups first.



# Class C Addresses

## VLSM Chart 24-30 Bits (4th octet)

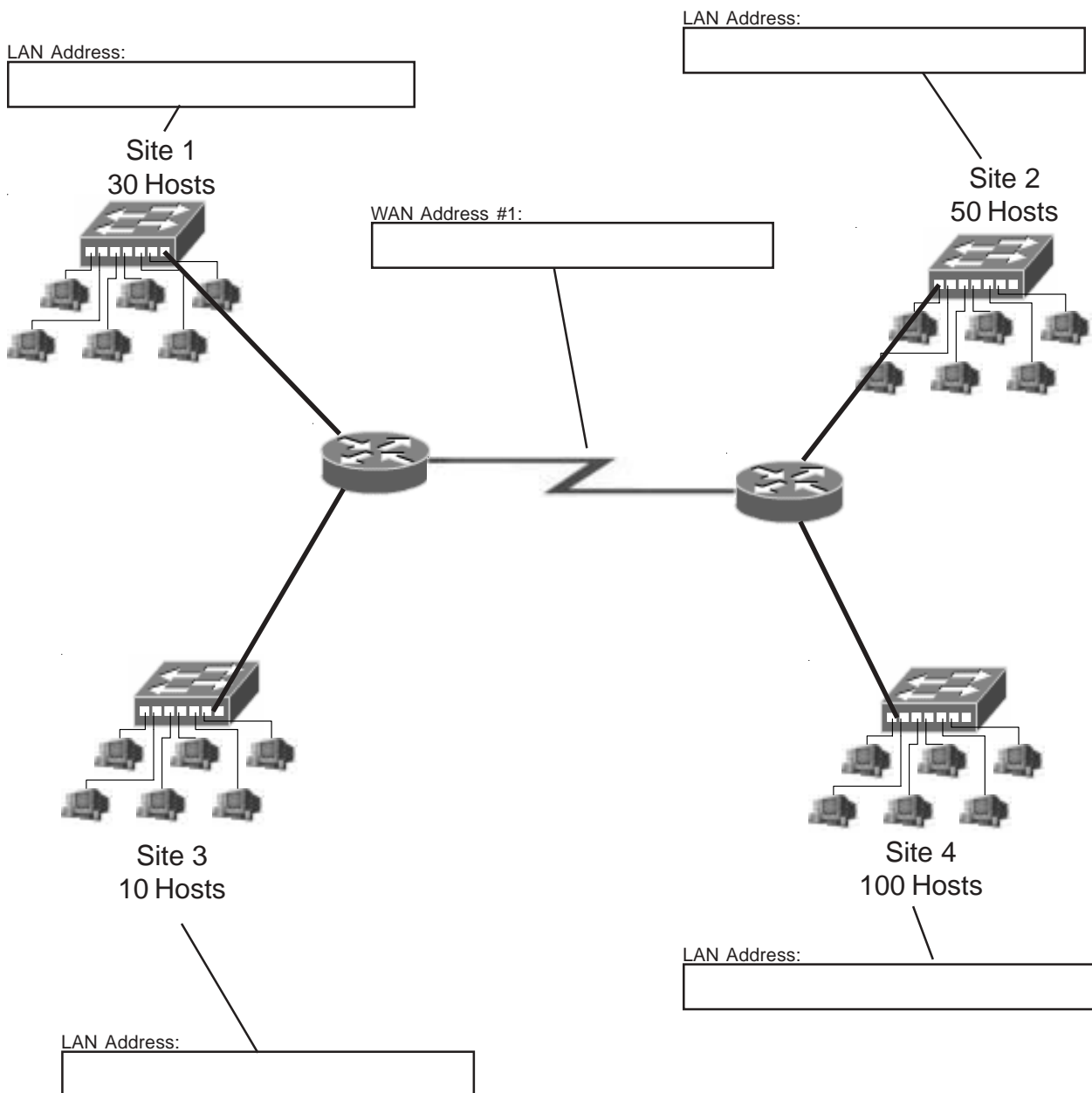
<b>/24</b> 255.255.255.0 256 Hosts	<b>/25</b> 255.255.255.128 128 Hosts	<b>/26</b> 255.255.255.192 64 Hosts	<b>/27</b> 255.255.255.224 32 Hosts	<b>/28</b> 255.255.255.240 16 Hosts	<b>/29</b> 255.255.255.248 8 Hosts	<b>/30</b> 255.255.255.252 4 Hosts	
0 - 255	0-127	0-63	0-31	0-15	0-7	0-3	
					8-15	4-7	
				16-31	8-11	12-15	
					16-19	20-23	
			32-63	32-47	24-27	28-31	
					32-39	32-35	
					40-47	36-39	
					48-63	40-43	
		64-95		64-79	44-47	48-51	
					48-55	52-55	
				80-95	56-63	56-59	
					64-71	60-63	
		128-255	128-191	128-159	128-143	64-71	64-67
						72-79	68-71
					144-159	80-87	80-83
						88-95	84-87
	160-191			160-175	96-111	88-91	
					176-191	92-95	
				192-207	96-103	96-99	
					104-111	100-103	
	192-255		192-223	192-207	104-107	104-107	
					108-111	108-111	
				208-223	112-119	112-115	
					120-127	116-119	
			224-255	224-239	128-135	120-123	
					136-143	124-127	
				240-255	144-151	128-131	
					152-159	132-135	
						136-139	140-143
						144-151	144-147
						152-159	148-151
						16-167	152-155
					168-175	156-159	
					176-183	160-163	
					184-191	164-167	
					192-199	168-171	
					200-207	172-175	
					208-215	176-179	
					216-223	180-183	
					224-231	184-187	
					232-239	188-191	
					240-247	192-195	
					248-255	196-199	
						200-203	
						204-207	
						208-211	
						212-215	
						216-219	
						220-223	
						224-227	
						228-231	
						232-235	
						236-239	
						240-243	
						244-247	
						248-251	
						252-255	

# VLSM Addressing

## VLSM Chart Method

### Problem 19

Using the network diagram and information given create an addressing scheme which utilizes variable-length subnet masks. Show the subnet address and CIDR in the boxes below, color or shade the sub-subnets used in the chart. This company will be using the class C address 199.55.78.0. Remember to start with your largest groups first.



# Class C Addresses

## VLSM Chart 24-30 Bits (4th octet)

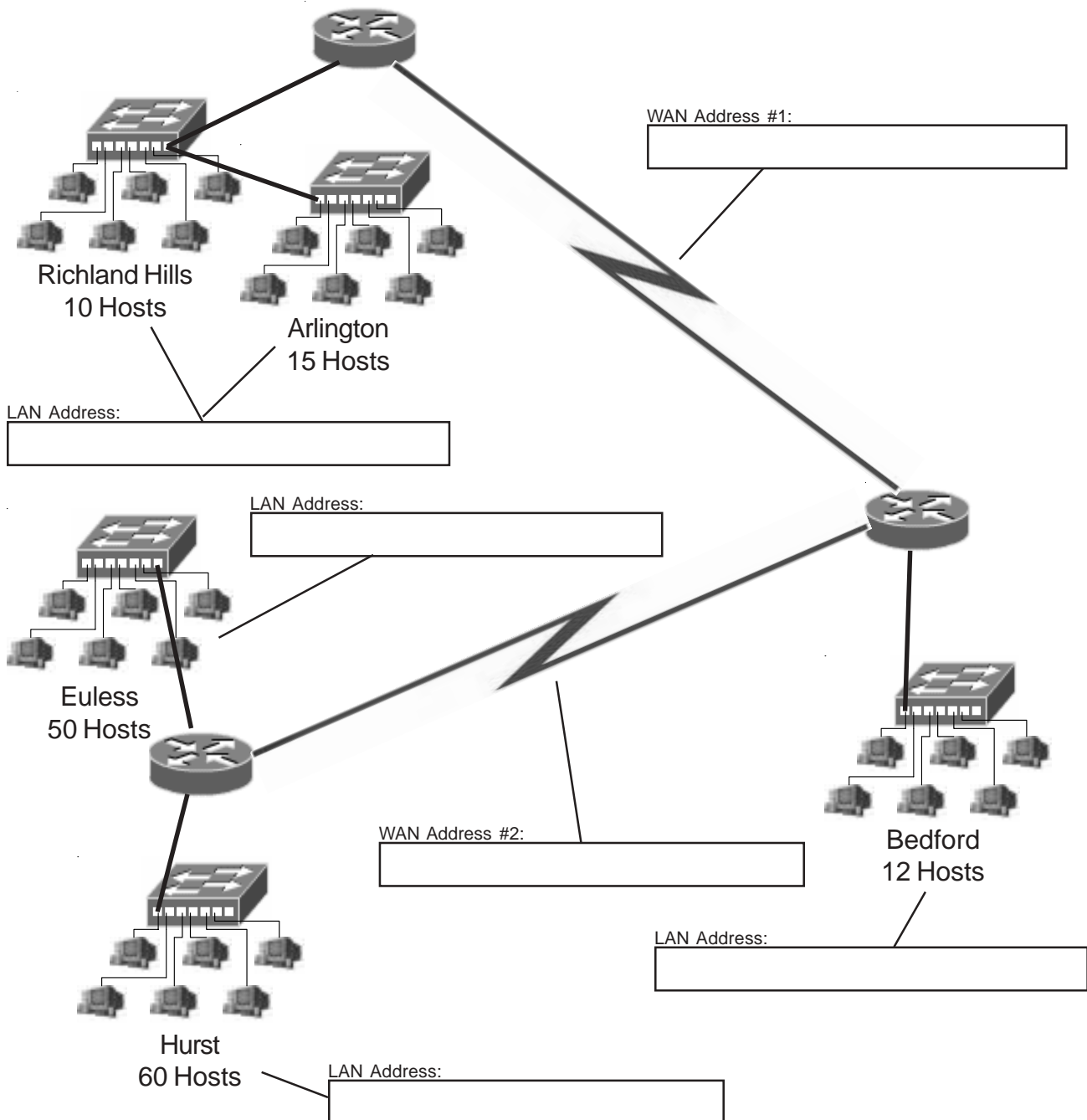
<b>/24</b>	<b>/25</b>	<b>/26</b>	<b>/27</b>	<b>/28</b>	<b>/29</b>	<b>/30</b>		
255.255.255.0 256 Hosts	255.255.255.128 128 Hosts	255.255.255.192 64 Hosts	255.255.255.224 32 Hosts	255.255.255.240 16 Hosts	255.255.255.248 8 Hosts	255.255.255.252 4 Hosts		
0 - 255	0-127	0-63	0-31	0-15	0-7	0-3		
					8-15	4-7	8-11	
				16-31	16-23	12-15	16-19	
					24-31	20-23	24-27	
			32-63	32-47	32-39	28-31	32-35	
					40-47	36-39	40-43	
					48-63	44-47	48-51	52-55
						56-63	56-59	60-63
		64-127		64-95	64-71	64-67	68-71	
					80-95	72-75	76-79	
					80-87	80-83	84-87	88-91
						88-95	92-95	96-99
			96-127	96-111	96-103	100-103	104-107	
					104-111	108-111	112-115	
				112-127	112-119	116-119	120-123	
					120-127	124-127	128-131	
	128-255	128-191	128-159	128-143	128-135	132-135		
				144-159	136-139	140-143		
				144-151	144-147	148-151	152-155	
					152-159	156-159	160-163	
			160-191	160-175	16-167	164-167	168-171	
					176-191	172-175	176-179	
				176-183	180-183	184-187	188-191	
					184-191	192-195	196-199	
		192-255	192-223	192-207	192-199	200-203	204-207	
					208-223	208-211	212-215	
				208-223	216-223	216-219	220-223	
					224-239	224-227	228-231	
			224-255	224-239	232-235	236-239	240-243	
					240-247	244-247	248-251	
				240-255	248-255	252-255		

# VLSM Addressing

## VLSM Chart Method

### Problem 20

Using the network diagram and information given create an addressing scheme which utilizes variable-length subnet masks. Show the subnet address and CIDR in the boxes below, color or shade the sub-subnets used in the chart. This company will be using the class C address 223.150.50.0. Remember to start with your largest groups first.





# Class C Addresses

## VLSM Chart 24-30 Bits (4th octet)

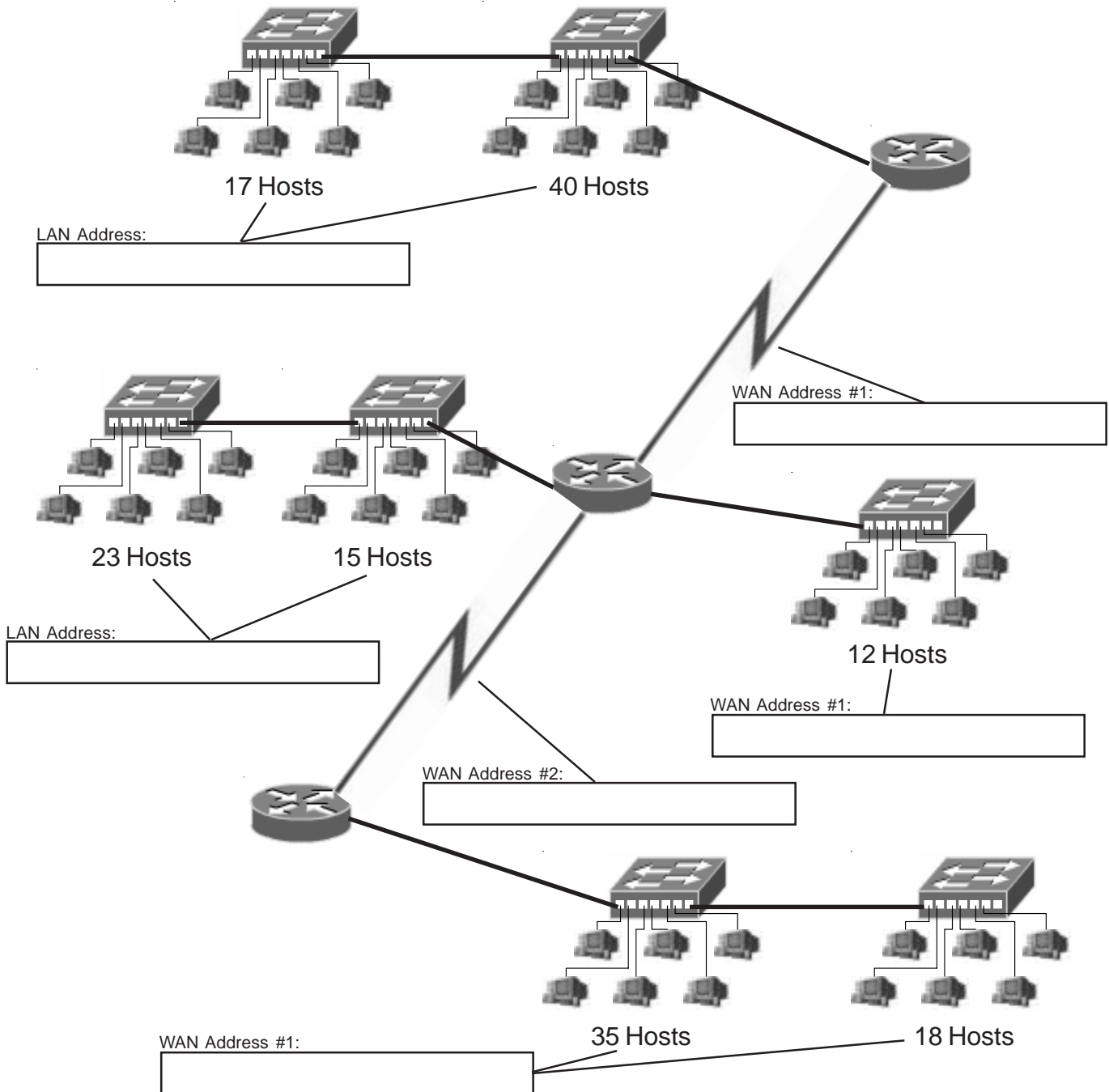
<b>/24</b> 255.255.255.0 256 Hosts	<b>/25</b> 255.255.255.128 128 Hosts	<b>/26</b> 255.255.255.192 64 Hosts	<b>/27</b> 255.255.255.224 32 Hosts	<b>/28</b> 255.255.255.240 16 Hosts	<b>/29</b> 255.255.255.248 8 Hosts	<b>/30</b> 255.255.255.252 4 Hosts
0 - 255	0-127	0-63	0-31	0-15	0-7	0-3
						4-7
					8-15	8-11
						12-15
			16-31	16-23	16-19	
					20-23	
				24-31	24-27	
					28-31	
		32-63	32-47	32-39	32-35	
					36-39	
				40-47	40-43	
					44-47	
			48-63	48-55	48-51	
					52-55	
				56-63	56-59	
					60-63	
	64-127	64-95	64-79	64-71	64-67	
					68-71	
				72-79	72-75	
					76-79	
			80-95	80-87	80-83	
					84-87	
				88-95	88-91	
					92-95	
		96-127	96-111	96-103	96-99	
					100-103	
				104-111	104-107	
					108-111	
			112-127	112-119	112-115	
					116-119	
				120-127	120-123	
					124-127	
128-255	128-191	128-159	128-143	128-131		
				132-135		
			136-143	136-139		
				140-143		
		144-159	144-151	144-147		
				148-151		
			152-159	152-155		
				156-159		
	160-191	160-175	160-163			
			164-167			
		168-175	168-171			
			172-175			
	176-191	176-183	176-179			
			180-183			
		184-191	184-187			
			188-191			
192-255	192-223	192-207	192-195			
			196-199			
		200-207	200-203			
			204-207			
	208-223	208-215	208-211			
			212-215			
		216-223	216-219			
			220-223			
224-239	224-231	224-227				
		228-231				
	232-239	232-235				
		236-239				
240-255	240-247	240-243				
		244-247				
	248-255	248-251				
		252-255				

# VLSM Addressing

## VLSM Chart Method

### Problem 21

Using the network diagram and information given create an addressing scheme which utilizes variable-length subnet masks. Show the subnet address and CIDR in the boxes below, color or shade the sub-subnets used in the chart. This company will be using the class C address 222.22.2.0. Remember to start with your largest groups first.



# Class C Addresses

## VLSM Chart 24-30 Bits (4th octet)

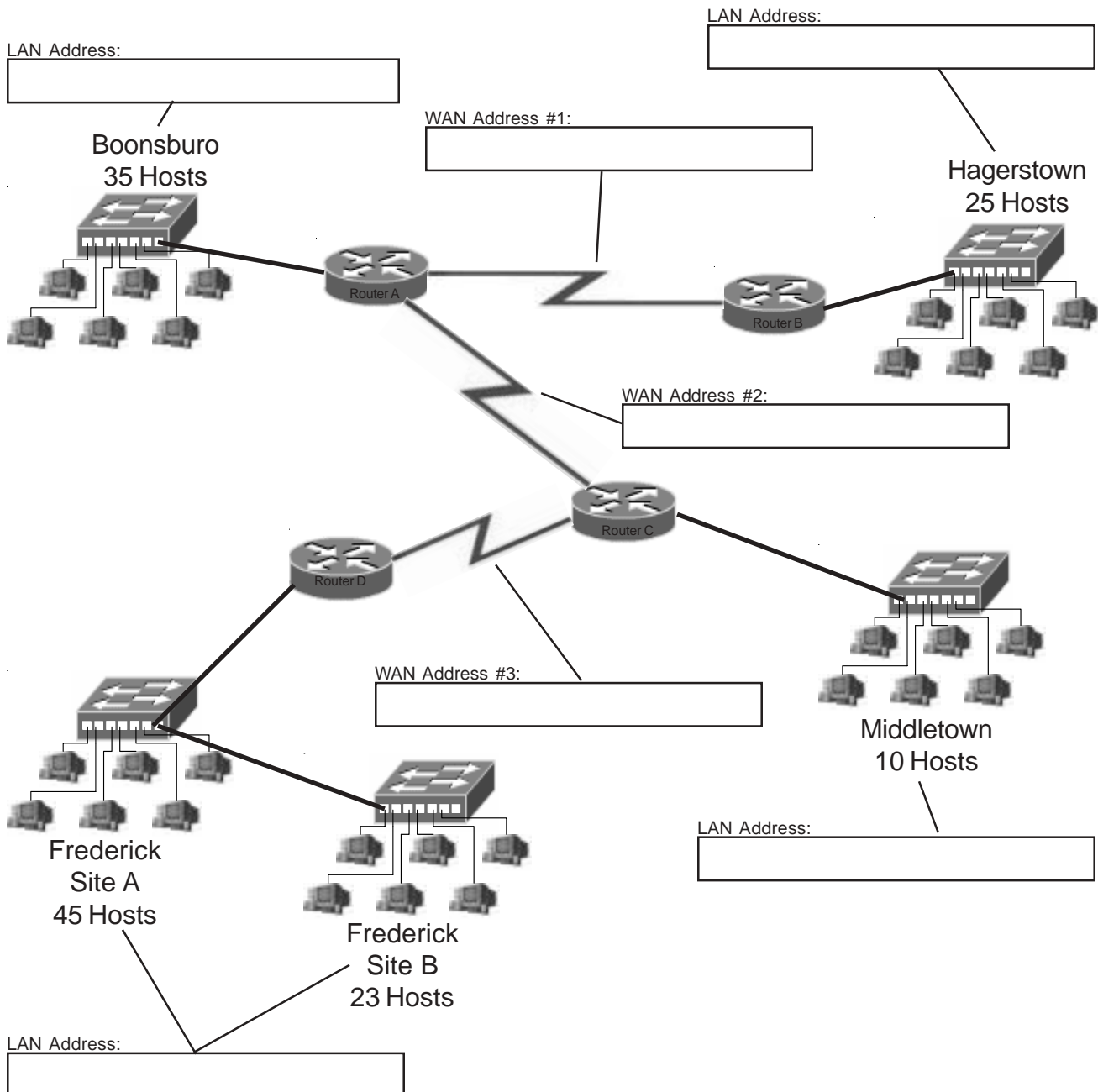
<b>/24</b> 255.255.255.0 256 Hosts	<b>/25</b> 255.255.255.128 128 Hosts	<b>/26</b> 255.255.255.192 64 Hosts	<b>/27</b> 255.255.255.224 32 Hosts	<b>/28</b> 255.255.255.240 16 Hosts	<b>/29</b> 255.255.255.248 8 Hosts	<b>/30</b> 255.255.255.252 4 Hosts		
0 - 255	0-127	0-63	0-31	0-15	0-7	0-3		
					8-15	4-7	8-11	
				16-31	16-23	12-15	16-19	
					24-31	20-23	24-27	
			32-63	32-47	32-39	28-31	32-35	
					40-47	36-39	40-43	
					48-63	44-47	48-51	52-55
						56-63	56-59	60-63
		64-127		64-95	64-79	64-71	64-67	68-71
						72-79	72-75	76-79
					80-95	80-87	80-83	84-87
						88-95	88-91	92-95
			96-127	96-111	96-103	96-99	100-103	
					104-111	104-107	108-111	
				112-127	112-119	112-115	116-119	
					120-127	120-123	124-127	
	128-255	128-191	128-159	128-143	128-135	128-131	132-135	
					136-143	136-139	140-143	
				144-159	144-151	144-147	148-151	
					152-159	152-155	156-159	
			160-191	160-175	16-167	160-163	164-167	
					168-175	168-171	172-175	
				176-191	176-183	176-179	180-183	
					184-191	184-187	188-191	
		192-255	192-223	192-207	192-199	192-195	196-199	
					200-207	200-203	204-207	
				208-223	208-215	208-211	212-215	
					216-223	216-219	220-223	
			224-255	224-239	224-231	224-227	228-231	
					232-239	232-235	236-239	
				240-255	240-247	240-243	244-247	
					248-255	248-251	252-255	

# VLSM Addressing

## VLSM Chart Method

### Problem 22

Using the network diagram and information given create an addressing scheme which utilizes variable-length subnet masks. Show the subnet address and CIDR in the boxes below, color or shade the sub-subnets used in the chart. This company will be using the class C address 200.20.2.0. Remember to start with your largest groups first.



# Class C Addresses

## VLSM Chart 24-30 Bits (4th octet)

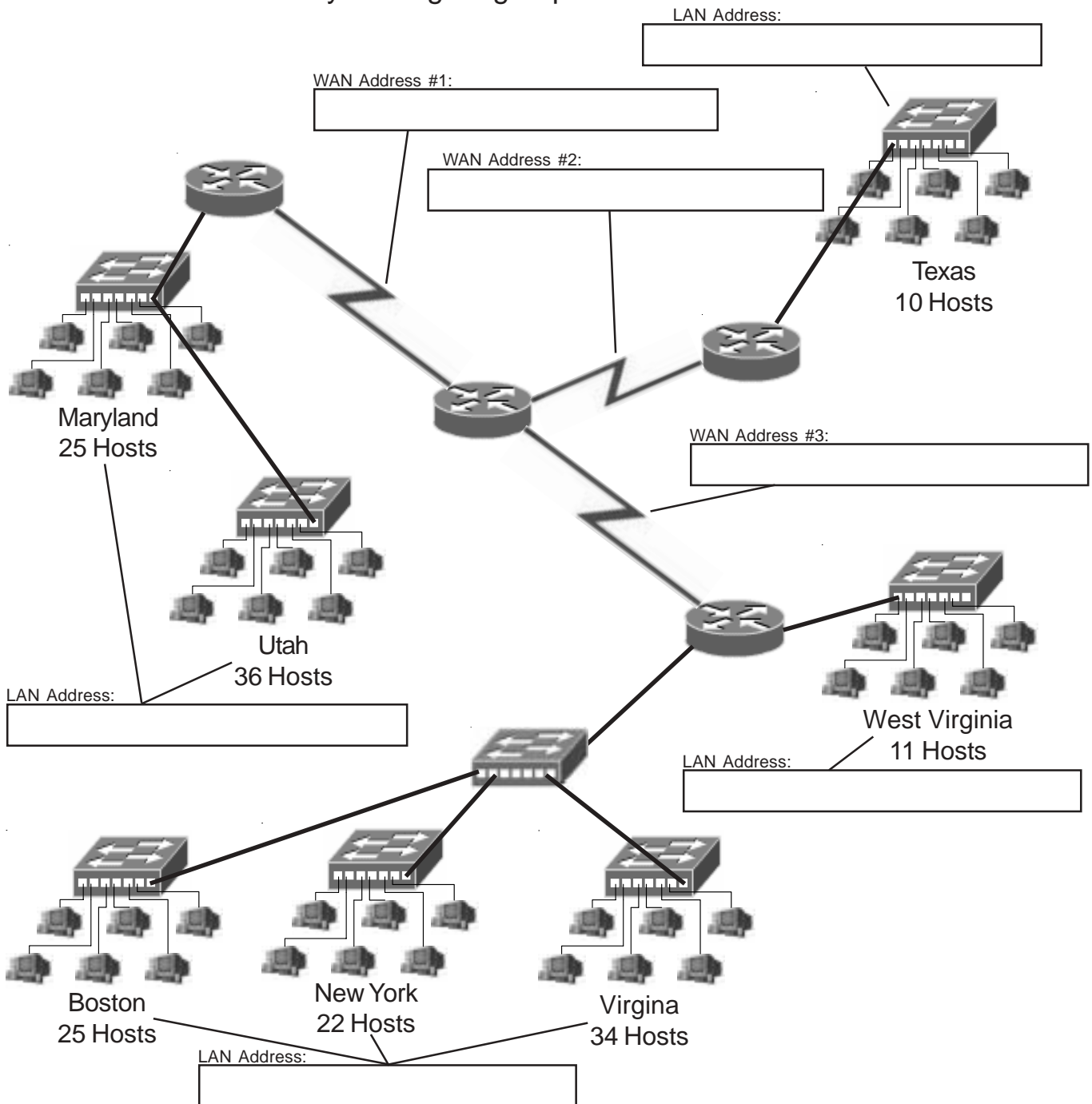
<b>/24</b> 255.255.255.0 256 Hosts	<b>/25</b> 255.255.255.128 128 Hosts	<b>/26</b> 255.255.255.192 64 Hosts	<b>/27</b> 255.255.255.224 32 Hosts	<b>/28</b> 255.255.255.240 16 Hosts	<b>/29</b> 255.255.255.248 8 Hosts	<b>/30</b> 255.255.255.252 4 Hosts
0 - 255	0-127	0-63	0-31	0-15	0-7	0-3
					8-15	4-7
				16-31	8-11	
					12-15	
			32-63	64-95	16-19	
					20-23	
					24-27	
					28-31	
		48-63		32-35		
				36-39		
				40-43		
				44-47		
		64-127	96-127	48-51		
				52-55		
				56-59		
				60-63		
	128-159		64-67			
			68-71			
			72-75			
			76-79			
	128-191	160-191	80-83			
			84-87			
			88-91			
			92-95			
		176-191	96-99			
			100-103			
			104-107			
			108-111			
	128-255	128-191	128-159	128-143	112-119	
					120-127	
				144-159	112-115	
					116-119	
160-191			120-123			
			124-127			
			128-131			
			132-135			
192-255		192-223	192-207	136-139		
				140-143		
			208-223	144-147		
				148-151		
		224-255	152-155			
			156-159			
			160-163			
			164-167			
240-255	224-239	224-239	168-171			
			172-175			
		240-247	176-179			
			180-183			
	248-255	184-187				
		188-191				
		192-195				
		196-199				
	240-247	240-247	200-203			
204-207						
248-255		208-211				
		212-215				
	248-255	248-255	216-219			
220-223						
252-255		224-227				
		228-231				
	248-255	248-255	232-235			
236-239						
252-255		240-243				
		244-247				
	248-255	248-255	248-251			
252-255						
		248-255	248-255	252-255		

# VLSM Addressing

## VLSM Chart Method

### Problem 23

Using the network diagram and information given create an addressing scheme which utilizes variable-length subnet masks. Show the subnet address and CIDR in the boxes below, color or shade the sub-subnets used in the chart. This company will be using the class C address 190.150.23.0. Remember to start with your largest groups first.



# Class C Addresses

## VLSM Chart 24-30 Bits (4th octet)

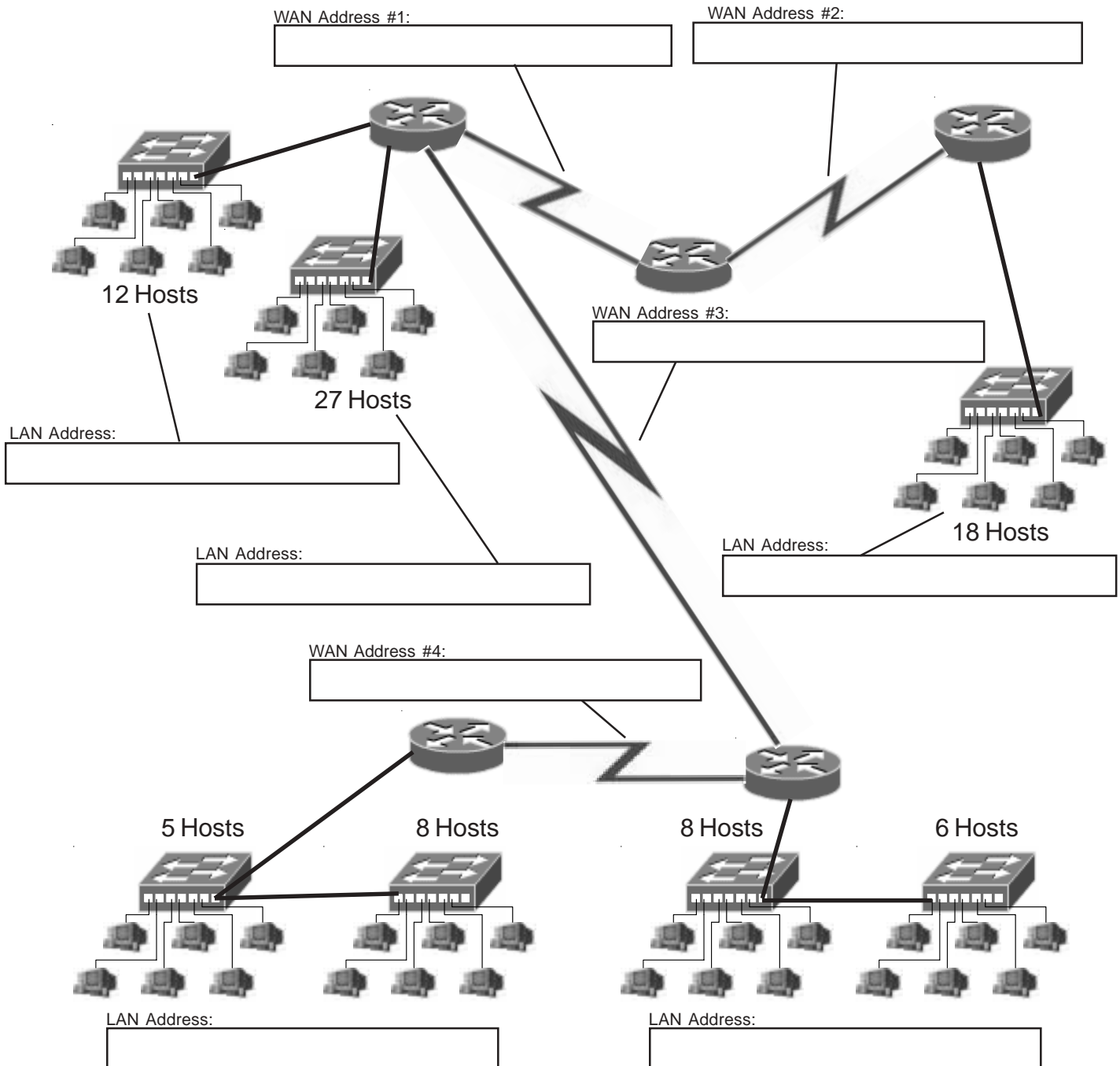
<b>/24</b> 255.255.255.0 256 Hosts	<b>/25</b> 255.255.255.128 128 Hosts	<b>/26</b> 255.255.255.192 64 Hosts	<b>/27</b> 255.255.255.224 32 Hosts	<b>/28</b> 255.255.255.240 16 Hosts	<b>/29</b> 255.255.255.248 8 Hosts	<b>/30</b> 255.255.255.252 4 Hosts
0 - 255	0-127	0-63	0-31	0-15	0-7	0-3
						4-7
					8-15	8-11
						12-15
			16-31	16-23	16-19	
					20-23	
				24-31	24-27	
					28-31	
		32-63	32-47	32-39	32-35	
					36-39	
				40-47	40-43	
					44-47	
			48-63	48-55	48-51	
					52-55	
				56-63	56-59	
					60-63	
	64-127	64-95	64-79	64-71	64-67	
					68-71	
				72-79	72-75	
					76-79	
			80-95	80-87	80-83	
					84-87	
				88-95	88-91	
					92-95	
		96-127	96-111	96-103	96-99	
					100-103	
				104-111	104-107	
					108-111	
			112-127	112-119	112-115	
					116-119	
				120-127	120-123	
					124-127	
128-255	128-191	128-159	128-143	128-131		
				132-135		
			136-143	136-139		
				140-143		
		144-159	144-151	144-147		
				148-151		
			152-159	152-155		
				156-159		
	160-191	160-167	160-163			
			164-167			
		168-175	168-171			
			172-175			
	176-191	176-183	176-179			
			180-183			
		184-191	184-187			
			188-191			
192-255	192-223	192-207	192-199	192-195		
				196-199		
		208-223	200-207	200-203		
				204-207		
	224-239	208-215	208-211			
			212-215			
		216-223	216-219			
			220-223			
224-255	224-239	224-231	224-227			
			228-231			
	240-255	232-239	232-235			
			236-239			
	240-247	240-243				
	248-255	248-251				
		252-255				

# VLSM Addressing

## VLSM Chart Method

### Problem 24

Using the network diagram and information given create an addressing scheme which utilizes variable-length subnet masks. Show the subnet address and CIDR in the boxes below, color or shade the sub-subnets used in the chart. This company will be using the class C address 192.168.1.0. Remember to start with your largest groups first.





# Class C Addresses

## VLSM Chart 24-30 Bits (4th octet)

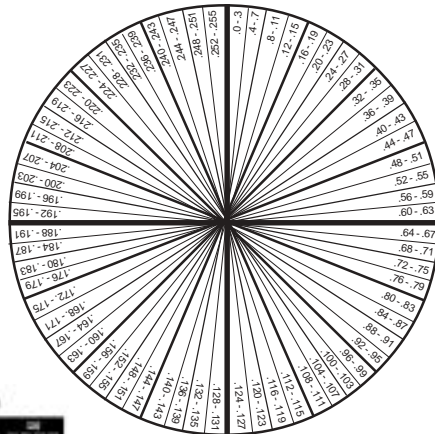
<b>/24</b> 255.255.255.0 256 Hosts	<b>/25</b> 255.255.255.128 128 Hosts	<b>/26</b> 255.255.255.192 64 Hosts	<b>/27</b> 255.255.255.224 32 Hosts	<b>/28</b> 255.255.255.240 16 Hosts	<b>/29</b> 255.255.255.248 8 Hosts	<b>/30</b> 255.255.255.252 4 Hosts
0 - 255	0-127	0-63	0-31	0-15	0-7	0-3
						4-7
					8-15	8-11
						12-15
			16-31	16-23	16-19	
					20-23	
				24-31	24-27	
					28-31	
		32-63	32-47	32-39	32-35	
					36-39	
				40-47	40-43	
					44-47	
			48-63	48-55	48-51	
					52-55	
				56-63	56-59	
					60-63	
	64-127	64-95	64-79	64-71	64-67	
					68-71	
					72-75	
					76-79	
			80-95	80-87	80-83	
					84-87	
				88-95	88-91	
					92-95	
		96-127	96-111	96-103	96-99	
					100-103	
				104-111	104-107	
					108-111	
			112-127	112-119	112-115	
					116-119	
				120-127	120-123	
					124-127	
128-255	128-191	128-159	128-143	128-131		
				132-135		
				136-139		
				140-143		
		144-159	144-151	144-147		
				148-151		
			152-159	152-155		
				156-159		
	160-191	160-175	16-167	160-163		
				164-167		
				168-171		
				172-175		
		176-191	176-183	176-179		
				180-183		
			184-191	184-187		
				188-191		
192-255	192-223	192-207	192-199	192-195		
				196-199		
				200-203		
				204-207		
		208-223	208-215	208-211		
				212-215		
			216-223	216-219		
				220-223		
	224-255	224-239	224-231	224-227		
				228-231		
				232-235		
				236-239		
		240-255	240-247	240-243		
				244-247		
			248-255	248-251		
				252-255		



# Practical VLSM Problems

Use the VLSM method of your choice to complete the following problems.

0	8	32	40	128	136	160	168	
4	3	11	35	43	131	139	163	171
7	12	38	44	132	140	164	172	
16	7	15	39	47	135	143	167	175
18	24	48	56	144	152	176	184	
19	27	51	59	147	155	179	187	
20	28	52	60	148	156	180	188	
23	31	55	63	151	159	183	191	
64	72	96	104	192	200	224	232	
67	75	99	107	195	203	227	235	
68	76	100	108	196	204	228	236	
71	79	103	111	199	207	231	239	
80	88	112	120	208	216	240	248	
83	91	115	123	211	219	243	251	
84	92	116	124	212	220	244	252	
87	95	119	127	215	223	247	255	



VLSM Chart 24-30 Bits (4th octet)

Subnet	Mask	Address	Mask	Address	Mask	Address	Mask	Address
192	/24	192.168.1.0	/24	192.168.1.0	/24	192.168.1.0	/24	192.168.1.0
192	/25	192.168.1.0	/25	192.168.1.0	/25	192.168.1.0	/25	192.168.1.0
192	/26	192.168.1.0	/26	192.168.1.0	/26	192.168.1.0	/26	192.168.1.0
192	/27	192.168.1.0	/27	192.168.1.0	/27	192.168.1.0	/27	192.168.1.0
192	/28	192.168.1.0	/28	192.168.1.0	/28	192.168.1.0	/28	192.168.1.0
192	/29	192.168.1.0	/29	192.168.1.0	/29	192.168.1.0	/29	192.168.1.0
192	/30	192.168.1.0	/30	192.168.1.0	/30	192.168.1.0	/30	192.168.1.0

## VLSM Addressing

(Sample)

### Problem 25

You are developing a school network with the class C address 192.168.2.0/24. There will be three computer labs with 30 computers each that need to be on different sub-subnets. Forty eight classrooms with one computer each that will comprise a single sub-subnet. The administrative office and guidance office contain a total of seven computers which will need to be grouped together. Plan for four more mini labs with six computers to each sub-subnetwork. Divide the network using variable length subnet masks. Complete the information required below. Remember to work from largest to smallest.

Subnet	Subnet Address	Subnet Mask (/X)	First Usable Host	Last Usable Host	Broadcast Address
1	192.168.2.0	/26	192.168.2.1	192.168.2.62	192.168.2.63
2	192.168.2.64	/27	192.168.2.65	192.168.2.94	192.168.2.95
3	192.168.2.96	/27	192.168.2.97	192.168.2.126	192.168.2.127
4	192.168.2.128	/27	192.168.2.129	192.168.2.158	192.168.2.159
5	192.168.2.160	/28	192.168.2.161	192.168.2.174	192.168.2.175
6	192.168.2.176	/29	192.168.2.177	192.168.2.182	192.168.2.183
7	192.168.2.184	/29	192.168.2.185	192.168.2.190	192.168.2.191
8	192.168.2.192	/29	192.168.2.193	192.168.2.198	192.168.2.199
9	192.168.2.200	/29	192.168.2.201	192.168.2.206	192.168.2.207
10					
11					
12					
13					
14					

## VLSM Addressing

(Sample)

### **Problem 26**

You are setting up a small business network with the class C address 220.55.80.0/24. The marketing division will need 12 computers. Research and development needs 27 computers. The reception area will need two computers. Management requires 19 computers. Divide the network using variable length subnet masks. Complete the information required below. Remember to work from largest to smallest.

Subnet	Subnet Address	Subnet Mask (/X)	First Usable Host	Last Usable Host	Broadcast Address
1	220.55.80.0	/27	220.55.80.1	220.55.80.30	220.55.80.31
2	220.55.80.32	/27	220.55.80.	220.55.80.62	220.55.80.63
3	220.55.80.64	/28	220.55.80.65	220.55.80.78	220.55.80.79
4	220.55.80.80	/30	220.55.80.81	220.55.80.82	220.55.80.83
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					

## VLSM Addressing

### **Problem 27**

You are setting up a medium sized network with the class C address 222.37.34.0/24. Marketing needs 29 computers. Research and development needs 110 computers. Bookkeeping will use 12 computers. The reception area will need three computers. Management requires 60 computers. Divide the network using variable length subnet masks. Complete the information required below. Remember to work from largest to smallest.

Subnet	Subnet Address	Subnet Mask (/X)	First Usable Host	Last Usable Host	Broadcast Address
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					

## VLSM Addressing

### **Problem 28**

A shipping company needs to set up its network across several locations. The Denver office needs six computers. The Waco office needs 22 computers. The Fargo office will need five computers. The WAN links between all three locations need to be included in the solution. Using the IP address 192.168.10.0/24 divide the network using VLSM. Complete the information required below. Remember to work from largest to smallest.

Subnet	Subnet Address	Subnet Mask (/X)	First Usable Host	Last Usable Host	Broadcast Address
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					

## VLSM Addressing

### **Problem 29**

A new school is being built in the local school district. It will have three computer labs with 28 computers each. There will be 58 classrooms with 2 computers each that need to be on one sub-subnet. The office staff and administrators will need 7 computers. The guidance and attendance office will have 5 computers. The school has been given the address 223.145.75.0/24. Complete the information required below. Remember to work from largest to smallest.

Subnet	Subnet Address	Subnet Mask (/X)	First Usable Host	Last Usable Host	Broadcast Address
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					



## VLSM Addressing

### **Problem 30**

A local college is setting up a campus wide network. The technology wing will be on its own network address of 192.168.250.0/24. The office wing will include 15 computers. There are 2 labs of 20 computers each, 2 labs of 30 computers each and one lab of 35 computers. Complete the information required below. Remember to work from largest to smallest.

Subnet	Subnet Address	Subnet Mask (/X)	First Usable Host	Last Usable Host	Broadcast Address
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					

## VLSM Addressing

### **Problem 31**

You are setting up a network for a company in four locations. Location A has 8 computers. Location B has 122 computers. Location C has 4 computers. Location D has 55 computers. There is a WAN connection between all four locations. Complete the information required below using the class C address 192.168.10.0. Remember to work from largest to smallest.

Subnet	Subnet Address	Subnet Mask (/X)	First Usable Host	Last Usable Host	Broadcast Address
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					

## VLSM Addressing

### **Problem 32**

A college dormitory is being remodeled. A new network is being installed. There are 50 dorm rooms with two drops each that will be on one sub-subnet. The offices will have 5 drops. The reception desk will have three drops. A small study hall will include 30 drops. Using the IP address 192.168.12.0/24 complete the information required below using VLSM. Work from largest to smallest.

Subnet	Subnet Address	Subnet Mask (/X)	First Usable Host	Last Usable Host	Broadcast Address
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					

## VLSM Addressing

### **Problem 33**

You are setting up a business network with the class C address 219.75.160.0/24. The marketing division will need 19 computers. Research and development needs 40 computers. The reception area will need four computers. Management requires 12 computers. Divide the network using variable length subnet information. On the opposite page draw a detailed map of this network. Include the name and sub-subnet IP addresses for each branch of the network with the subnet mask. One router with four ethernet ports will be used for this network.

Subnet	Subnet Address	Subnet Mask (/X)	First Usable Host	Last Usable Host	Broadcast Address
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					

### **Problem 33 - Detailed Map**

Draw a detailed map of this network. Include the name and sub-subnet IP addresses information for each branch of the network, and the subnet mask.

## VLSM Addressing

### Problem 34

A small company needs to set up its network across several locations. The New York branch office needs 15 computers. The San Jose office needs 66 computers. The Trinidad office will need 18 computers. You will need two WAN links between the routers. Using the IP address 195.20.5.0/24 divide the network using VLSM. On the opposite page draw a detailed map of this network. Include the name and subnet IP addresses information for each branch of the network. Label the WAN links with the same information. Complete the information required below. Work from largest to smallest.

Subnet	Subnet	Subnet Mask (/X)	First Usable Host	Last Usable Host	Broadcast Address
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					

### **Problem 34 - Detailed Map**

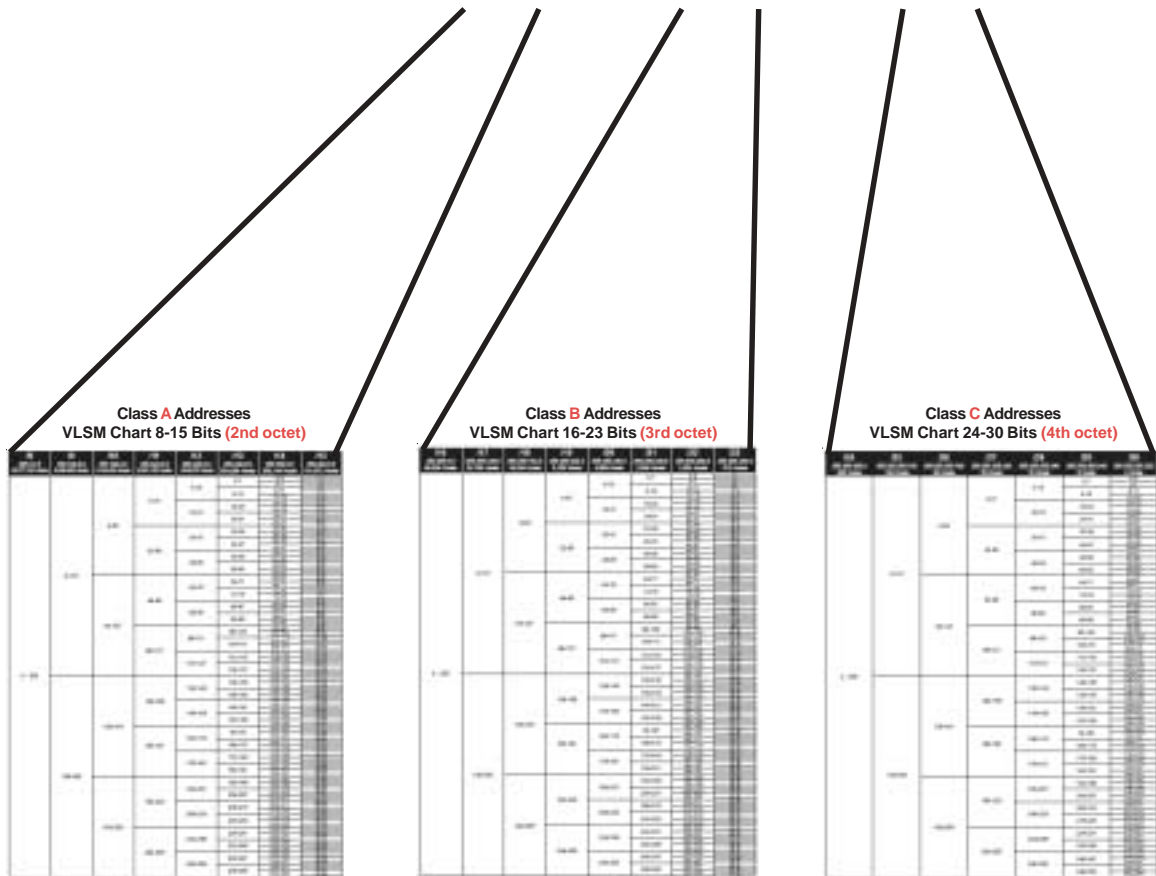
Draw a detailed map of this network. Include the name and sub-subnet IP addresses information for each branch of the network.





# Class A and B VLSM Problems

10 . 0 . 0 . 0



# VLSM

with

## Class A and B Addresses

We've gone over the practical applications of using VLSM on class C addresses. The same approach works with class A and B addresses. For example an ISP may have a class A address which it needs to subnet between its customers. Each customer may need to take their addresses and subnet them again in order to use them more effectively. The real trick to this is to remember which octet of the IP address you are working with.

### Sample Problem 35

#### Part 1 of 3

Use the **Class A** address chart to break down the address for different ISP customers. At this stage of the problem you are creating subnets using the second octet of the IP address.

### ISP Addresses 15.0.0.0

Customer Name	Number of Addresses	Address Range (Include subnet & broadcast addresses)	CIDR
Customer #1	8 million	15.0.0.0 to 15.127.255.255	/9
Customer #2	2 million	15.128.0.0 to 15.159.255.255	/11
Customer #3	2,000,000	15.160.0.0 to 15.191.255.255	/11
Customer #4	1,000,000	15.192.0.0 to 15.207.255.255	/12
Customer #5	500,000	15.208.0.0 to 15.215.255.255	/13
Customer #6	450,000	15.216.0.0 to 15.223.255.255	/13
Customer #7	200,000	15.224.0.0 to 15.227.255.255	/14
Customer #8	130,000	15.228.0.0 to 15.229.255.255	/15
Customer #9	100,000	15.230.0.0 to 15.231.255.255	/15

# Class A Addresses

## VLSM Chart 8-15 Bits (2nd octet)

/8 255.0.0.0 16,777,216 Hosts	/9 255.128.0.0 8,388,608 Hosts	/10 255.192.0.0 4,194,304 Hosts	/11 255.224.0.0 2,097,152 Hosts	/12 255.240.0.0 1,048,576 Hosts	/13 255.248.0.0 524,288 Hosts	/14 255.252.0.0 262,144 Hosts	/15 255.254.0.0 131,072 Hosts	
0 - 255	0-127	0-63	0-31	0-15	0-7	0-3	0-1	
				16-31	8-15	4-7	2-3	
				32-63	32-39	16-19	8-9	4-5
					40-47	20-23	6-7	10-11
			48-63		24-27	12-15	12-13	14-15
					32-35	16-17	18-19	20-21
			36-39	20-21	22-23	24-25	26-27	
			40-41	28-29	30-31	32-33	34-35	
		42-43	32-33	34-35	36-37	38-39		
		44-45	40-41	42-43	44-47	48-49		
		46-47	48-49	50-51	52-55	56-57		
		48-49	52-53	54-55	56-57	58-59		
		50-51	56-57	58-59	60-63	64-65		
		52-53	60-61	62-63	64-67	66-67		
		54-55	62-63	64-65	68-69	70-71		
		56-57	64-65	66-67	72-73	74-75		
	58-59	66-67	68-69	76-77	78-79			
	60-61	68-69	70-71	80-81	82-83			
	62-63	72-73	74-75	84-85	86-87			
	64-65	76-77	78-79	88-89	90-91			
	66-67	80-81	82-83	92-93	94-95			
	68-69	84-85	86-87	96-97	98-99			
	70-71	88-89	90-91	100-103	102-103			
	72-73	92-93	94-95	104-107	104-105			
	74-75	96-97	98-99	108-111	106-107			
	76-77	100-101	102-103	112-115	108-109			
	78-79	102-103	104-105	116-117	110-111			
	80-81	104-105	106-107	120-123	112-113			
	82-83	106-107	108-109	124-127	114-115			
	84-85	108-109	110-111	128-129	116-117			
	86-87	110-111	112-113	130-131	118-119			
	88-89	112-113	114-115	132-135	120-121			
90-91	114-115	116-117	136-137	122-123				
92-93	116-117	118-119	140-143	124-125				
94-95	118-119	120-121	144-147	126-127				
96-97	120-121	122-123	148-151	128-129				
98-99	122-123	124-125	152-155	130-131				
100-101	124-125	126-127	156-159	132-133				
102-103	126-127	128-129	160-163	134-135				
104-105	128-129	130-131	164-167	136-137				
106-107	130-131	132-133	168-171	138-139				
108-109	132-133	134-135	172-175	140-141				
110-111	134-135	136-137	176-179	142-143				
112-113	136-137	138-139	180-183	144-145				
114-115	138-139	140-141	184-187	146-147				
116-117	140-141	142-143	188-191	148-149				
118-119	142-143	144-145	192-195	150-151				
120-121	144-145	146-147	196-199	152-153				
122-123	146-147	148-149	200-203	154-155				
124-125	148-149	150-151	204-207	156-157				
126-127	150-151	152-153	208-211	158-159				
128-129	152-153	154-155	212-215	160-161				
130-131	154-155	156-157	216-219	162-163				
132-133	156-157	158-159	220-223	164-165				
134-135	158-159	160-163	224-227	166-167				
136-137	160-161	162-163	228-231	168-169				
138-139	162-163	164-165	232-235	170-171				
140-141	164-165	166-167	236-239	172-173				
142-143	166-167	168-169	240-243	174-175				
144-145	168-169	170-171	244-247	176-177				
146-147	170-171	172-173	248-251	178-179				
148-149	172-173	174-175	252-255	180-181				
150-151	174-175	176-177		182-183				
152-153	176-177	178-179		184-185				
154-155	178-179	180-181		186-187				
156-157	180-181	182-183		188-189				
158-159	182-183	184-185		190-191				
160-161	184-185	186-187		192-193				
162-163	186-187	188-189		194-195				
164-165	188-189	190-191		196-197				
166-167	190-191	192-193		198-199				
168-169	192-193	194-195		200-201				
170-171	194-195	196-197		202-203				
172-173	196-197	198-199		204-205				
174-175	198-199	200-201		206-207				
176-177	200-201	202-203		208-209				
178-179	202-203	204-205		210-211				
180-181	204-205	206-207		212-213				
182-183	206-207	208-209		214-215				
184-185	208-209	210-211		216-217				
186-187	210-211	212-213		218-219				
188-189	212-213	214-215		220-221				
190-191	214-215	216-217		222-223				
192-193	216-217	218-219		224-225				
194-195	218-219	220-221		226-227				
196-197	220-221	222-223		228-229				
198-199	222-223	224-225		230-231				
200-201	224-225	226-227		232-233				
202-203	226-227	228-229		234-235				
204-205	228-229	230-231		236-237				
206-207	230-231	232-233		238-239				
208-209	232-233	234-235		240-241				
210-211	234-235	236-237		242-243				
212-213	236-237	238-239		244-245				
214-215	238-239	240-241		246-247				
216-217	240-241	242-243		248-249				
218-219	242-243	244-245		250-251				
220-221	244-245	246-247		252-253				
222-223	246-247	248-249		254-255				
224-225	248-249	250-251						
226-227	250-251	252-253						
228-229	252-253	254-255						
230-231	254-255							
232-233								
234-235								
236-237								
238-239								
240-241								
242-243								
244-245								
246-247								
248-249								
250-251								
252-253								
254-255								

# VLSM

with

## Class A and B Addresses

### Sample Problem 35

### Part 2 of 3

Customer #5 has a total of 524,288 addresses. Use the **Class B** address chart to break down the sub-subnetwork addresses for their different clients. At this stage of the problem you are creating sub-subnets with the third octet of the IP address.

ISP Addresses 15.208.0.0

Customer Name	Number of Addresses	Address Range (Include subnet & broadcast addresses)	CIDR
Client #1	7,500	15.208.0.0 to 15.208.31.255	/19
Client #2	5,000	15.208.32.0 to 15.208.63.255	/19
Client #3	4,500	15.208.64.0 to 15.208.95.255	/19
Client #4	2,000	15.208.96.0 to 15.208.103.255	/21
Client #5	1,450	15.208.104.0 to 15.208.111.255	/21
Client #6	1,150	15.208.112.0 to 15.208.119.255	/21
Client #7	900	15.208.120.0 to 15.208.123.255	/22
Client #8	750	15.208.124.0 to 15.208.127.255	/22
Client #9	450	15.208.128.0 to 15.208.129.255	/23

# Class B Addresses

## VLSM Chart 16-23 Bits (3rd octet)

/16 255.255.0.0 65,536 Hosts	/17 255.255.128.0 32,768 Hosts	/18 255.255.192.0 16,384 Hosts	/19 255.255.224.0 8,192 Hosts	/20 255.255.240.0 4,096 Hosts	/21 255.255.248.0 2,048 Hosts	/22 255.255.252.0 1,024 Hosts	/23 255.255.254.0 512 Hosts	
0 - 255	0-127	0-63	0-31	0-15	0-7	0-3	0-1	
					8-15	4-7	2-3	
				16-31	16-23	8-11	4-5	
					24-31	12-15	6-7	
					32-47	16-19	10-11	8-9
						20-23	12-13	10-11
			24-27			14-15	12-13	
			28-31			16-17	14-15	
			48-63	32-35	18-19	16-17		
				36-39	20-21	18-19		
				40-47	22-23	20-21		
				80-95	44-47	24-25	22-23	
		48-51			26-27	24-25		
		52-55			28-29	26-27		
		56-59	30-31		28-29			
		64-127	64-95	64-79	60-63	32-33	32-35	30-31
					80-87	34-35	32-33	
					88-95	36-37	34-35	
				96-111	80-87	40-43	36-37	
					88-95	44-47	38-39	
					96-111	96-103	48-49	40-41
			104-111			50-51	42-43	
			112-127			112-119	52-55	44-45
						120-127	56-57	46-47
	128-255		128-191	128-159	64-67	58-59	56-57	54-55
					128-143	60-61	58-59	56-57
					136-143	62-63	60-61	58-59
		144-159			128-143	64-65	62-63	60-61
					144-151	66-67	64-65	62-63
					152-159	68-69	66-67	64-65
				160-175	144-151	70-71	68-69	66-67
					160-167	72-73	70-71	68-69
					168-175	74-75	72-73	70-71
		176-191			160-167	76-77	74-75	72-73
				176-183	78-79	76-77	74-75	
				184-191	80-81	78-79	76-77	
			192-199	176-183	82-83	80-81	78-79	
				184-191	84-85	82-83	80-81	
				192-199	86-87	84-85	82-83	
		196-199		88-89	86-87	84-85		
		192-255	192-223	192-207	90-91	88-89	86-87	84-85
					200-207	90-91	88-89	86-87
					204-207	92-93	90-91	88-89
				208-223	200-207	94-95	92-93	90-91
					208-215	96-97	94-95	92-93
					216-223	98-99	96-97	94-95
			224-239		208-215	100-103	98-99	96-97
					216-223	104-107	100-101	98-99
	224-231				108-111	102-103	100-101	
	232-239			112-115	104-105	102-103		
	240-255		224-255	240-247	106-107	106-107	104-105	102-103
					248-251	108-109	106-107	104-105
240-247		110-111		108-109	106-107			
248-255		112-115	110-111	108-109	106-107			
		244-247	112-113	110-111	108-109			
		248-251	114-115	112-113	110-111			
						116-117	114-115	
						118-119	116-117	
						120-121	118-119	
						122-123	120-121	
						124-125	122-123	
						126-127	124-125	
						128-129	126-127	
						130-131	128-129	
						132-133	130-131	
						134-135	132-133	
						136-137	134-135	
						138-139	136-137	
						140-141	138-139	
						142-143	140-141	
						144-145	142-143	
						146-147	144-145	
						148-149	146-147	
						150-151	148-149	
						152-153	150-151	
						154-155	152-153	
						156-157	154-155	
						158-159	156-157	
						160-161	158-159	
						162-163	160-161	
						164-165	162-163	
						166-167	164-165	
						168-169	166-167	
						170-171	168-169	
						172-173	170-171	
						174-175	172-173	
						176-177	174-175	
						178-179	176-177	
						180-181	178-179	
						182-183	180-181	
						184-185	182-183	
						186-187	184-185	
						188-189	186-187	
						190-191	188-189	
						192-193	190-191	
						194-195	192-193	
						196-197	194-195	
						198-199	196-197	
						200-201	198-199	
						202-203	200-201	
						204-205	202-203	
						206-207	204-205	
						208-209	206-207	
						210-211	208-209	
						212-213	210-211	
						214-215	212-213	
						216-217	214-215	
						218-219	216-217	
						220-221	218-219	
						222-223	220-221	
						224-225	222-223	
						226-227	224-225	
						228-229	226-227	
						230-231	228-229	
						232-233	230-231	
						234-235	232-233	
						236-237	234-235	
						238-239	236-237	
						240-241	238-239	
						242-243	240-241	
						244-245	242-243	
						246-247	244-245	
						248-249	246-247	
						250-251	248-249	
						252-253	250-251	
						254-255	252-253	
							254-255	

# VLSM

with

## Class A and B Addresses

### Sample Problem 35

### Part 3 of 3

Client #8 has a total of 1,024 addresses. Use the **Class C** address chart to break down the sub-subnetwork addresses for their different branch offices. At this stage of the problem you are creating sub-subnets with the fourth octet of the IP address.

ISP Addresses 15.208.124.**0**

Customer Name	Number of Addresses	Address Range (Include subnet & broadcast addresses)	CIDR
Branch #1	100	<i>15.208.124.0 to 15.208.124.127</i>	<i>/25</i>
Branch #2	55	<i>15.208.124.128 to 15.208.124.191</i>	<i>/26</i>
Branch #3	25	<i>15.208.124.192 to 15.208.124.223</i>	<i>/27</i>
Branch #4	6	<i>15.208.124.224 to 15.208.124.231</i>	<i>/29</i>
Branch #5	4	<i>15.208.124.232 to 15.208.124.239</i>	<i>/29</i>
Branch #6	2	<i>15.208.124.240 to 15.208.124.243</i>	<i>/30</i>
Branch #7	2	<i>15.208.124.244 to 15.208.124.247</i>	<i>/30</i>
Branch #8	2	<i>15.208.124.248 to 15.208.124.251</i>	<i>/30</i>
Branch #9	2	<i>15.208.124.252 to 15.208.124.255</i>	<i>/30</i>

# Class C Addresses

## VLSM Chart 24-30 Bits (4th octet)

<b>/24</b> 255.255.255.0 256 Hosts	<b>/25</b> 255.255.255.128 128 Hosts	<b>/26</b> 255.255.255.192 64 Hosts	<b>/27</b> 255.255.255.224 32 Hosts	<b>/28</b> 255.255.255.240 16 Hosts	<b>/29</b> 255.255.255.248 8 Hosts	<b>/30</b> 255.255.255.252 4 Hosts
0 - 255	0-127	0-63	0-31	0-15	0-7	0-3
					8-15	4-7
					16-23	8-11
					24-31	12-15
			16-31		16-19	
					20-23	
					24-27	
					28-31	
		32-63	32-47		32-35	
					36-39	
					40-43	
					44-47	
			48-63		48-51	
					52-55	
					56-59	
					60-63	
	64-127	64-95	64-79		64-67	
					68-71	
					72-75	
					76-79	
			80-95		80-83	
					84-87	
					88-91	
					92-95	
		96-127	96-111		96-99	
					100-103	
					104-107	
					108-111	
			112-127		112-115	
					116-119	
					120-123	
					124-127	
128-255	128-191	128-159		128-131		
				132-135		
				136-139		
				140-143		
		144-159		144-147		
				148-151		
				152-155		
				156-159		
	160-191	160-175		160-163		
				164-167		
				168-171		
				172-175		
		176-191		176-179		
				180-183		
				184-187		
				188-191		
192-255	192-223	192-207		192-195		
				196-199		
				200-203		
				204-207		
		208-223		208-211		
				212-215		
				216-219		
				220-223		
	224-255	224-239		224-227		
				228-231		
				232-235		
				236-239		
		240-255		240-243		
				244-247		
				248-251		
				252-255		

# VLSM

with

## Class A and B Addresses

### Problem 36

### Part 1 of 3

The school system you are working for is using the private address of 172.32.0.0 to subnet the entire district. Use the **Class B** address chart to break down the sub-subnetwork addresses for the different schools and offices.

At this stage of the problem you are creating sub-subnets with the third octet of the IP address. Remember which octet of the IP address you are working in.

School System Address 172.32.0.0

Customer Name	Number of Addresses	Address Range (Include subnet & broadcast addresses)	CIDR
North High	2,400		
South High	2,000		
North Middle	1,200		
South Middle	1,000		
Central Elem.	550		
Southern Elem.	475		
Eastern Elem.	450		
Central Office	400		
Western Elem.	300		



# Class B Addresses

## VLSM Chart 16-23 Bits (3rd octet)

<b>/16</b> 255.255.0.0 65,536 Hosts	<b>/17</b> 255.255.128.0 32,768 Hosts	<b>/18</b> 255.255.192.0 16,384 Hosts	<b>/19</b> 255.255.224.0 8,192 Hosts	<b>/20</b> 255.255.240.0 4,096 Hosts	<b>/21</b> 255.255.248.0 2,048 Hosts	<b>/22</b> 255.255.252.0 1,024 Hosts	<b>/23</b> 255.255.254.0 512 Hosts		
0 - 255	0-127	0-63	0-31	0-15	0-7	0-3	0-1		
					8-15	4-7	4-5		
				16-31	16-23	8-11	6-7		
					24-31	12-15	8-9		
					32-47	32-39	16-19	10-11	
						40-47	20-23	12-13	
			48-63			48-55	24-27	14-15	
						56-63	28-31	16-17	
				64-127		64-95	64-71	30-31	18-19
							80-95	32-35	20-21
					96-111		96-103	36-39	22-23
							104-111	40-43	24-25
		112-127	112-119				44-47	26-27	
			120-127				48-51	28-29	
			128-191			128-159	128-143	52-55	30-31
							144-159	56-59	32-33
					160-191		160-175	60-63	34-35
							176-191	64-67	36-37
		192-223					192-199	68-71	38-39
							200-207	72-75	40-41
				192-255		192-207	76-79	42-43	
						208-215	80-83	44-45	
					224-239	208-223	84-87	46-47	
						216-223	88-91	48-49	
	240-255	224-231				92-95	50-51		
		232-239				96-99	52-53		
		240-247	240-247	100-103		54-55			
			248-255	248-251		104-107	56-57		
				248-251	108-111	58-59			
				248-251	112-115	60-61			
	248-251			116-117	62-63				
	248-251			118-119	64-65				
	248-251	120-121		66-67					
	248-251	122-123	68-69						
	248-251	124-125	70-71						
	248-251	126-127	72-73						
	248-251	128-129	74-75						
	248-251	130-131	76-77						
	248-251	132-133	78-79						
	248-251	134-135	80-81						
	248-251	136-137	82-83						
	248-251	138-139	84-85						
	248-251	140-141	86-87						
	248-251	142-143	88-89						
	248-251	144-145	90-91						
	248-251	146-147	92-93						
	248-251	148-149	94-95						
	248-251	150-151	96-97						
	248-251	152-153	98-99						
	248-251	154-155	100-101						
	248-251	156-157	102-103						
	248-251	158-159	104-105						
248-251	160-161	106-107							
248-251	162-163	108-109							
248-251	164-165	110-111							
248-251	166-167	112-113							
248-251	168-169	114-115							
248-251	170-171	116-117							
248-251	172-173	118-119							
248-251	174-175	120-121							
248-251	176-177	122-123							
248-251	178-179	124-125							
248-251	180-181	126-127							
248-251	182-183	128-129							
248-251	184-185	130-131							
248-251	186-187	132-133							
248-251	188-189	134-135							
248-251	190-191	136-137							
248-251	192-193	138-139							
248-251	194-195	140-141							
248-251	196-197	142-143							
248-251	198-199	144-145							
248-251	200-201	146-147							
248-251	202-203	148-149							
248-251	204-205	150-151							
248-251	206-207	152-153							
248-251	208-209	154-155							
248-251	210-211	156-157							
248-251	212-213	158-159							
248-251	214-215	160-161							
248-251	216-217	162-163							
248-251	218-219	164-165							
248-251	220-221	166-167							
248-251	222-223	168-169							
248-251	224-225	170-171							
248-251	226-227	172-173							
248-251	228-229	174-175							
248-251	230-231	176-177							
248-251	232-233	178-179							
248-251	234-235	180-181							
248-251	236-237	182-183							
248-251	238-239	184-185							
248-251	240-241	186-187							
248-251	242-243	188-189							
248-251	244-245	190-191							
248-251	246-247	192-193							
248-251	248-249	194-195							
248-251	250-251	196-197							
248-251	252-253	198-199							
248-251	254-255	200-201							
248-251	254-255	202-203							
248-251	254-255	204-205							
248-251	254-255	206-207							
248-251	254-255	208-209							
248-251	254-255	210-211							
248-251	254-255	212-213							
248-251	254-255	214-215							
248-251	254-255	216-217							
248-251	254-255	218-219							
248-251	254-255	220-221							
248-251	254-255	222-223							
248-251	254-255	224-225							
248-251	254-255	226-227							
248-251	254-255	228-229							
248-251	254-255	230-231							
248-251	254-255	232-233							
248-251	254-255	234-235							
248-251	254-255	236-237							
248-251	254-255	238-239							
248-251	254-255	240-241							
248-251	254-255	242-243							
248-251	254-255	244-245							
248-251	254-255	246-247							
248-251	254-255	248-249							
248-251	254-255	250-251							
248-251	254-255	252-253							
248-251	254-255	254-255							

# VLSM

with

## Class A and B Addresses

### Problem 36

### Part 2 of 3

Eastern Elementary has been given 512 hosts, with the address range of 172.32.42.0 / 21 (255.255.248.0).

Based on the information below supply the required address ranges and subnet masks for each school area. Use the **Class C** address chart to break down the sub-subnetworks.

#### **Hint:**

Another way to look at this problem is to see that with the third octet range of 42 to 43 you have access to 2 groups of 255 addresses (172.32.42.0 and 172.32.43.0). Think in terms of having two Class C VLSM charts.

Eastern Elementary School  
Address Range 172.32.**42.0** to 172.32.**43.255**

Customer Name	Number of Addresses	Address Range (Include subnet & broadcast addresses)	CIDR
Students	250		
Printers	45		
Staff	40		
Network Devices	25		
Administrative	12		

# Class C Addresses

## VLSM Chart 24-30 Bits (4th octet)

<b>/24</b>	<b>/25</b>	<b>/26</b>	<b>/27</b>	<b>/28</b>	<b>/29</b>	<b>/30</b>
255.255.255.0 256 Hosts	255.255.255.128 128 Hosts	255.255.255.192 64 Hosts	255.255.255.224 32 Hosts	255.255.255.240 16 Hosts	255.255.255.248 8 Hosts	255.255.255.252 4 Hosts
0 - 255	0-127	0-63	0-31	0-15	0-7	0-3
					8-15	4-7
				16-31		8-11
						12-15
			32-63	32-47	16-19	
					20-23	
					24-27	
					28-31	
		48-63		32-35		
				36-39		
				40-43		
				44-47		
		64-127	64-95	48-51		
				52-55		
				56-59		
				60-63		
	96-127		64-71	64-67		
			72-79	68-71		
			80-87	72-75		
			88-95	76-79		
	128-255	128-191	128-159	80-83	80-83	
				84-87	84-87	
				88-91	88-91	
				92-95	92-95	
			160-191	96-99	96-99	
				100-103	100-103	
				104-107	104-107	
				108-111	108-111	
		192-255	192-223	112-115	112-115	
				116-119	116-119	
				120-123	120-123	
				124-127	124-127	
224-255			128-131	128-131		
			132-135	132-135		
			136-139	136-139		
			140-143	140-143		
240-255	208-223	144-147	144-147			
		148-151	148-151			
		152-155	152-155			
		156-159	156-159			
	240-255	160-163	160-163			
		164-167	164-167			
		168-171	168-171			
		172-175	172-175			
248-255	224-239	176-179	176-179			
		180-183	180-183			
		184-187	184-187			
		188-191	188-191			
	248-255	192-195	192-195			
		196-199	196-199			
		200-203	200-203			
		204-207	204-207			
252-255	240-255	208-211	208-211			
		212-215	212-215			
		216-219	216-219			
		220-223	220-223			
	252-255	224-227	224-227			
		228-231	228-231			
		232-235	232-235			
		236-239	236-239			
252-255	240-255	240-243	240-243			
		244-247	244-247			
		248-251	248-251			
		252-255	252-255			
	252-255	244-247	244-247			
		248-251	248-251			
		252-255	252-255			
		252-255	252-255			

# VLSM

with

## Class A and B Addresses

### Problem 36

### Part 3 of 3

South High in part 1 of this problem has been given 2,048 hosts, with the address range of 172.32.16.0 / 21 (255.255.248.0).

Based on the information below supply the required address ranges and subnet masks for each school area. Use both the **Class B** and **Class C** address charts to break down the sub-subnetwork addresses for the different areas of the network.

### **Hint:**

With this problem you are creating sub-subnets with both the third and fourth octets of the IP address. You may need to use the Class B VLSM chart for the *Students* addressing information. All the other addresses will be using the Class C VLSM chart. Another way to look at this problem is to see that with the third octet range of 16 to 23 you have access to 8 groups of 255 addresses or eight Class C VLSM charts.

South High School  
Address Range 172.32.**16.0** to 172.32.**23.255**

Customer Name	Number of Addresses	Address Range (Include subnet & broadcast addresses)	CIDR
Students	1,000		
Network Devices	250		
Printers	200		
Staff	150		
Administrative	50		

# Class C Addresses

## VLSM Chart 24-30 Bits (4th octet)

<b>/24</b> 255.255.255.0 256 Hosts	<b>/25</b> 255.255.255.128 128 Hosts	<b>/26</b> 255.255.255.192 64 Hosts	<b>/27</b> 255.255.255.224 32 Hosts	<b>/28</b> 255.255.255.240 16 Hosts	<b>/29</b> 255.255.255.248 8 Hosts	<b>/30</b> 255.255.255.252 4 Hosts
0 - 255	0-127	0-63	0-31	0-15	0-7	0-3
					8-15	4-7
				16-31	16-23	8-11
					24-31	12-15
			32-63	32-47	16-19	
					20-23	
					24-27	
					28-31	
		48-63		32-35		
				36-39		
				40-43		
				44-47		
		64-127	64-95	48-51		
				52-55		
				56-59		
				60-63		
	96-127		64-67			
			68-71			
			72-75			
			76-79			
	128-255	128-191	128-159	80-83		
				84-87		
				88-91		
				92-95		
			160-191	96-99		
				100-103		
				104-107		
				108-111		
		192-255	192-223	112-115		
				116-119		
				120-123		
				124-127		
224-255			128-131			
			132-135			
			136-139			
			140-143			
	144-147					
	148-151					
	152-155					
	156-159					
	160-163					
	164-167					
	168-171					
	172-175					
	176-179					
	180-183					
	184-187					
	188-191					
	192-195					
	196-199					
	200-203					
	204-207					
	208-211					
	212-215					
	216-219					
	220-223					
	224-227					
	228-231					
	232-235					
	236-239					
	240-243					
	244-247					
	248-251					
	252-255					

# VLSM

with

## Class A and B Addresses

### Problem 37

### Part 1 of 3

The company you are working for is using the IP address 110.0.0.0 sub-subneted for multiple offices around the world. Use the **Class A** address chart to break down the sub-subnetwork addresses for the different offices.

At this stage of the problem you are creating sub-subnets with the third octet of the IP address. Remember which octet of the IP address you are working in.

Company Address 110.0.0.0

Customer Name	Number of Addresses	Address Range (Include subnet & broadcast addresses)	CIDR
Moskva	3,050,000		
New York	1,540,000		
St. Petersburg	1,075,000		
London	975,000		
Ekaterinoburg	525,000		
Munchen	450,000		
Napoli	150,000		
Birmingham	130,000		
Rotterdam	95,000		

# Class A Addresses

## VLSM Chart 8-15 Bits (2nd octet)

/8 255.0.0.0 16,777,216 Hosts	/9 255.128.0.0 8,388,608 Hosts	/10 255.192.0.0 4,194,304 Hosts	/11 255.224.0.0 2,097,152 Hosts	/12 255.240.0.0 1,048,576 Hosts	/13 255.248.0.0 524,288 Hosts	/14 255.252.0.0 262,144 Hosts	/15 255.254.0.0 131,072 Hosts		
0 - 255	0-127	0-63	0-31	0-15	0-7	0-3	0-1		
				8-15	4-7	4-5			
				16-31	8-11	6-7	8-9		
					12-15	10-11	12-13		
					16-19	14-15	16-17		
			20-23		18-19	20-21			
			24-27		22-23	24-25			
			32-47	28-31	26-27	28-29			
				32-35	30-31	32-33			
				36-39	32-33	34-35			
				40-43	36-37	38-39			
				44-47	40-41	42-43			
			48-63	48-55	44-45	46-47			
				52-55	48-49	50-51			
				56-59	52-53	54-55			
				60-63	56-57	58-59			
				64-67	60-61	62-63			
			64-127	64-95	64-79	64-71	64-71	64-67	64-65
						72-79	68-71	66-67	68-69
						80-95	72-75	70-71	72-73
							76-79	72-73	74-75
							80-87	76-77	78-79
					84-87		80-81	82-83	
					88-91		84-85	86-87	
					96-127	96-111	96-103	88-91	88-89
		100-103					92-93	92-93	94-95
		104-107					96-97	96-97	98-99
		108-111		100-101			102-103	104-105	
		112-115		104-105			106-107	108-109	
		112-127		112-119		112-115	108-109	110-111	112-113
						116-119	112-113	114-115	116-117
						120-123	116-117	118-119	120-121
						124-127	120-123	122-123	124-125
						128-135	128-131	126-127	128-129
				132-135			128-129	130-131	
				136-143			136-137	132-133	134-135
							138-139	136-137	138-139
							140-143	140-141	142-143
						144-151	144-147	144-145	146-147
		148-151			148-149		150-151		
		152-159		152-155	152-153		154-155		
				156-159	156-157		158-159		
			160-167	160-163	160-161		162-163		
				164-167	162-163	164-165			
				168-175	168-171	166-167	168-169		
		172-175			168-169	170-171			
		176-183			172-173	172-173	174-175		
			176-177		176-177	178-179			
			180-183		180-181	182-183			
			184-191	184-187	182-183	184-185			
	188-191			186-187	188-189				
	192-199	192-195		188-189	190-191				
		196-199		192-193	194-195				
		200-207		196-197	196-197	198-199			
			200-203	198-199	200-201				
			204-207	200-203	202-203				
	208-215		204-205	202-203	204-205				
			208-209	206-207	208-209				
		212-215	208-209	210-211					
		216-223	212-215	210-211	212-213				
			216-217	212-213	214-215				
	218-219		216-217	218-219					
	220-223		220-221	222-223					
	224-227		222-223	224-225					
	224-239	224-227	226-227	228-229					
		228-231	228-229	230-231					
		232-235	230-231	232-233					
		236-239	232-233	234-235					
		240-247	236-237	236-237	238-239				
	240-243		240-241	242-243					
	244-247		242-243	244-245					
	248-255		244-247	244-245	246-247				
			248-251	246-247	248-249				
		252-255	248-249	250-251					
		252-255	252-253	252-253	254-255				
			254-255	254-255	254-255				

# VLSM

with

## Class A and B Addresses

### Problem 37

### Part 2 of 3

London in part 1 of this problem has been given 1,048,576 hosts, with the address range of 110.128.0.0 to 110.143.255.255 /12 (255.240.0.0).

Based on the information below supply the required address ranges and subnet masks for each office. Use the **Class B** address chart to break down the sub-subnetwork addresses for the different areas of the network.

London  
Address Range 110.128.0.0 to 110.143.255.255

Customer Name	Number of Addresses	Address Range (Include subnet & broadcast addresses)	CIDR
Office #1	6,450		
Office #2	3,780		
Office #3	2,750		
Office #4	2,000		
Office #5	1,000		
Office #6	845		
Office #7	500		
Office #8	450		
Office #9	300		



# Class B Addresses

## VLSM Chart 16-23 Bits (3rd octet)

/16 255.255.0.0 65,536 Hosts	/17 255.255.128.0 32,768 Hosts	/18 255.255.192.0 16,384 Hosts	/19 255.255.224.0 8,192 Hosts	/20 255.255.240.0 4,096 Hosts	/21 255.255.248.0 2,048 Hosts	/22 255.255.252.0 1,024 Hosts	/23 255.255.254.0 512 Hosts			
0 - 255	0-127	0-63	0-31	0-15	0-7	0-3	0-1			
					8-15	4-7	4-5			
				16-31	8-11	6-7	8-9			
					12-15	10-11	12-13			
					16-19	14-15	16-17			
			32-63	32-47	16-23	18-19	20-21			
					24-31	22-23	24-25			
				48-63	32-39	26-27	28-29			
					40-47	30-31	32-33			
					44-47	34-35	36-37			
		64-127	64-95	64-79	48-55	38-39	40-41	42-43		
					56-63	44-45	46-47	48-49		
					64-71	50-51	52-53	54-55		
				80-95	72-79	56-57	58-59	60-61		
					80-87	62-63	64-65	66-67		
			96-127	96-111	88-95	68-71	68-69	70-71	72-73	
					96-103	72-75	74-75	76-77	78-79	
				104-111	100-103	80-83	80-81	82-83	84-85	86-87
					104-107	88-91	88-89	90-91	92-93	94-95
					108-111	92-95	96-97	98-99	100-101	102-103
			112-127	112-119	104-105	96-99	104-105	106-107	108-109	
					106-107	108-109	110-111	112-113	114-115	
				120-127	116-117	110-111	112-113	114-115	116-117	118-119
					118-119	120-121	122-123	124-125	126-127	128-129
					120-123	122-123	124-125	126-127	128-129	130-131
	128-255	128-191	128-159	128-143	128-135	128-131	132-133			
					136-143	132-135	134-135			
				144-159	136-137	136-137	138-139			
					144-151	140-141	142-143			
					148-151	144-145	146-147			
			160-191	160-175	152-159	148-149	150-151	152-153		
					160-167	154-155	156-157	158-159		
				176-191	168-175	160-163	162-163	164-165		
					172-175	164-167	166-167	168-169		
					176-179	168-171	170-171	172-173		
		192-255	192-223	192-199	176-183	172-175	174-175	176-177		
					180-183	176-179	178-179	180-181		
				200-207	184-191	180-183	182-183	184-185		
					192-199	184-187	186-187	188-189		
					200-203	188-191	190-191	192-193		
			208-223	208-215	192-199	192-195	194-195	196-197		
					200-207	196-199	198-199	200-201		
				216-223	204-207	200-203	202-203	204-205		
					208-211	204-207	206-207	208-209		
					212-215	208-211	210-211	212-213		
			224-255	224-231	216-219	212-215	214-215	216-217		
					220-223	216-219	218-219	220-221		
				232-239	224-227	220-223	222-223	224-225		
					228-231	224-227	226-227	228-229		
					232-235	228-231	230-231	232-233		
240-255	240-247	232-235	232-235	234-235	236-237					
		236-239	236-239	238-239	240-241					
	248-255	240-243	240-243	242-243	244-245					
		244-247	244-247	246-247	248-249					
		248-251	248-251	250-251	252-253					
				252-253	254-255	254-255				

# VLSM

with

## Class A and B Addresses

### Problem 37

### Part 3 of 3

Office #7 in part 2 of this problem has been given 512 hosts, with the address range of 110.128.80.0 / 23 (255.255.254.0).

Based on the information below supply the required address ranges and subnet masks for each school area. Use the **Class C** address chart to break down the sub-subnetwork addresses for the different areas of the network. **Hint:** Another way to look at this problem is to see that with the third octet range of 80 to 81 you have access to 2 groups of 255 addresses or two Class C VLSM charts.

Office #7  
Address Range 110.128.**80.0** to 110.128.**81.255**

Customer Name	Number of Addresses	Address Range	CIDR
1st Floor	125		
2nd Floor	75		
5th Floor	50		
8th Floor	45		
4th Floor	30		
Basement	14		
7th Floor	12		
3rd Floor	6		
6th Floor	4		

# Class C Addresses

## VLSM Chart 24-30 Bits (4th octet)

<b>/24</b> 255.255.255.0 256 Hosts	<b>/25</b> 255.255.255.128 128 Hosts	<b>/26</b> 255.255.255.192 64 Hosts	<b>/27</b> 255.255.255.224 32 Hosts	<b>/28</b> 255.255.255.240 16 Hosts	<b>/29</b> 255.255.255.248 8 Hosts	<b>/30</b> 255.255.255.252 4 Hosts
0 - 255	0-127	0-63	0-31	0-15	0-7	0-3
					8-15	4-7
				16-31	8-11	
					12-15	
				16-23	16-19	
				24-31	20-23	
					24-27	
					28-31	
				32-35		
		32-63	32-47	32-39	36-39	
					40-43	
					44-47	
					48-51	
			48-63	48-55	52-55	
					56-59	
					60-63	
				64-67		
	64-127	64-95	64-79	64-71	64-67	
					68-71	
					72-75	
					76-79	
			80-95	80-87	80-83	
					84-87	
					88-91	
					92-95	
		96-127	96-111	96-103	96-99	
					100-103	
					104-107	
					108-111	
			112-127	112-119	112-115	
					116-119	
					120-123	
				124-127		
128-255	128-191	128-159	128-143	128-131		
				132-135		
				136-139		
				140-143		
		144-159	144-151	144-147		
				148-151		
				152-155		
				156-159		
	160-191	160-175	160-167	160-163		
				164-167		
				168-171		
				172-175		
		176-191	176-183	176-179		
				180-183		
				184-187		
				188-191		
192-255	192-223	192-207	192-199	192-195		
				196-199		
				200-203		
				204-207		
		208-223	208-215	208-211		
				212-215		
				216-219		
				220-223		
	224-255	224-239	224-231	224-227		
				228-231		
				232-235		
				236-239		
		240-255	240-247	240-243		
				244-247		
				248-251		
				252-255		

# VLSM

with

## Class A and B Addresses

### Problem 38

#### Part 1 of 4

Use the **Class A** address chart to break down the address for different business customers by country. At this stage of this problem you are creating subnets in the second octet of the IP address.

Addresses 75.0.0.0

Customer Name	Number of Addresses	Address Range	CIDR
United States	6.5 million		
China	4 million		
Japan	1 million		
Germany	500,000		
Russia	455,000		
Australia	450,000		
Brazil	125,000		
Canda	90,000		
Denmark	88,000		

# Class A Addresses

## VLSM Chart 8-15 Bits (2nd octet)

/8	/9	/10	/11	/12	/13	/14	/15		
255.0.0.0 16,777,216 Hosts	255.128.0.0 8,388,608 Hosts	255.192.0.0 4,194,304 Hosts	255.224.0.0 2,097,152 Hosts	255.240.0.0 1,048,576 Hosts	255.248.0.0 524,288 Hosts	255.252.0.0 262,144 Hosts	255.254.0.0 131,072 Hosts		
0 - 255	0-127	0-63	0-31	0-15	0-7	0-3	0-1		
					8-15	4-7	2-3		
				16-31	16-23	8-11	4-5		
					24-31	12-15	6-7		
					32-39	16-19	8-9		
				32-63	32-47	20-23	12-13	10-11	
						40-47	14-15	16-17	
			48-63		24-27	18-19	18-19		
					56-63	20-23	20-21		
					64-71	22-23	22-23		
			64-127		64-95	64-79	24-27	24-27	24-25
							80-87	28-31	26-27
				80-95		32-35	32-33	34-35	
						88-95	36-39	36-37	
		96-103				38-39	38-39		
		96-111		96-111		40-41	40-41	40-41	
						104-111	42-43	42-43	
				112-127	112-119	44-47	44-45		
					120-127	46-47	46-47		
					128-135	48-49	48-49		
				128-191	128-159	128-143	48-55	48-51	50-51
							136-143	52-55	52-53
		144-159				56-59	56-59	54-55	
						152-159	60-63	56-57	
			160-167			64-67	58-59		
		160-191	160-175			64-71	64-67	60-61	
						168-175	68-71	62-63	
			176-191		72-79	72-75	64-65		
	184-191				76-79	66-67			
	192-199				80-83	68-69			
	192-255		192-223		192-207	80-87	84-87	70-71	
						200-207	88-91	72-73	
		208-223			88-95	88-91	74-75		
					216-223	92-95	76-77		
				224-231	96-99	78-79			
		224-255		224-239	96-103	100-103	80-81		
					232-239	104-107	82-83		
			240-247	104-111	108-111	84-85			
				240-247	112-115	86-87			
				248-255	116-119	88-89			
			248-255	120-123	90-91				
			252-255	124-127	92-93				
		252-255	128-131	94-95					
		252-255	132-135	96-97					
	252-255	136-139	98-99						
	252-255	140-143	100-101						
	252-255	144-147	102-103						
	252-255	148-151	104-105						
	252-255	152-155	106-107						
	252-255	156-159	108-109						
	252-255	160-163	110-111						
	252-255	164-167	112-113						
252-255	168-171	114-115							
252-255	172-175	116-117							
252-255	176-179	118-119							
252-255	180-183	120-121							
252-255	184-187	122-123							
252-255	188-191	124-125							
252-255	192-195	126-127							
252-255	196-199	128-129							
252-255	200-203	130-131							
252-255	204-207	132-133							
252-255	208-211	134-135							
252-255	212-215	136-137							
252-255	216-219	138-139							
252-255	220-223	140-141							
252-255	224-227	142-143							
252-255	228-231	144-145							
252-255	232-235	146-147							
252-255	236-239	148-149							
252-255	240-243	150-151							
252-255	244-247	152-153							
252-255	248-251	154-155							
252-255	252-255	156-157							
252-255	252-255	158-159							
252-255	252-255	160-161							
252-255	252-255	162-163							
252-255	252-255	164-165							
252-255	252-255	166-167							
252-255	252-255	168-169							
252-255	252-255	170-171							
252-255	252-255	172-173							
252-255	252-255	174-175							
252-255	252-255	176-177							
252-255	252-255	178-179							
252-255	252-255	180-181							
252-255	252-255	182-183							
252-255	252-255	184-185							
252-255	252-255	186-187							
252-255	252-255	188-189							
252-255	252-255	190-191							
252-255	252-255	192-193							
252-255	252-255	194-195							
252-255	252-255	196-197							
252-255	252-255	198-199							
252-255	252-255	200-201							
252-255	252-255	202-203							
252-255	252-255	204-205							
252-255	252-255	206-207							
252-255	252-255	208-209							
252-255	252-255	210-211							
252-255	252-255	212-213							
252-255	252-255	214-215							
252-255	252-255	216-217							
252-255	252-255	218-219							
252-255	252-255	220-221							
252-255	252-255	222-223							
252-255	252-255	224-225							
252-255	252-255	226-227							
252-255	252-255	228-229							
252-255	252-255	230-231							
252-255	252-255	232-233							
252-255	252-255	234-235							
252-255	252-255	236-237							
252-255	252-255	238-239							
252-255	252-255	240-241							
252-255	252-255	242-243							
252-255	252-255	244-245							
252-255	252-255	246-247							
252-255	252-255	248-249							
252-255	252-255	250-251							
252-255	252-255	252-253							
252-255	252-255	254-255							

# VLSM

with

## Class A and B Addresses

### Sample Problem 38

#### Part 2 of 4

The United States customers have a total of 8,388,608 addresses. Use the **Class A** address chart to break down the sub-subnetwork addresses for their different areas. At this stage of this problem you are creating sub-subnets in the second octet of the IP address.

Addresses Range: 75.0.0.0 to 75.127.255.255

Customer Name	Number of Addresses	Address Range	CIDR
Client #1	1,950,000		
Client #2	1,000,000		
Client #3	950,000		
Client #4	700,000		
Client #5	550,000		
Client #6	500,000		
Client #7	450,000		

# Class A Addresses

## VLSM Chart 8-15 Bits (2nd octet)

/8 255.0.0.0 16,777,216 Hosts	/9 255.128.0.0 8,388,608 Hosts	/10 255.192.0.0 4,194,304 Hosts	/11 255.224.0.0 2,097,152 Hosts	/12 255.240.0.0 1,048,576 Hosts	/13 255.248.0.0 524,288 Hosts	/14 255.252.0.0 262,144 Hosts	/15 255.254.0.0 131,072 Hosts							
0 - 255	0-127	0-63	0-31	0-15	0-7	0-3 2-3 2-5 6-7 8-9 10-11 12-13 14-15	0-1 2-3 2-5 6-7 8-9 10-11 12-13 14-15							
					8-15	16-19 20-21 22-23 24-25 26-27 28-29 30-31 32-33 34-35 36-37 38-39 40-41 42-43 44-45 46-47 48-49 50-51 52-53 54-55 56-57 58-59 60-61 62-63 64-65 66-67 68-69 70-71 72-73 74-75 76-77 78-79 80-81 82-83 84-85 86-87 88-89 90-91 92-93 94-95 96-97 98-99 100-101 102-103 104-105 106-107 108-109 110-111 112-113 114-115 116-117 118-119 120-121 122-123 124-125 126-127 128-129 130-131 132-133 134-135 136-137 138-139 140-141 142-143 144-145 146-147 148-149 150-151 152-153 154-155 156-157 158-159 160-161 162-163 164-165 166-167 168-169 170-171 172-173 174-175 176-177 178-179 180-181 182-183 184-185 186-187 188-189 190-191 192-193 194-195 196-197 198-199 200-201 202-203 204-205 206-207 208-209 210-211 212-213 214-215 216-217 218-219 220-221 222-223 224-225 226-227 228-229 230-231 232-233 234-235 236-237 238-239 240-241 242-243 244-245 246-247 248-249 250-251 252-253 254-255								
				16-31	32-39 40-47 48-55 56-63	64-71 72-79 80-87 88-95	96-103 104-111 112-119 120-127	128-135 136-143 144-151 152-159	160-167 168-175 176-183 184-191	192-199 200-207 208-215 216-223	224-231 232-239 240-247 248-255			
				32-63	64-95	96-127	128-159	160-191	176-191	192-223	224-255			
				128-255	128-191	128-159	128-143	128-143	128-135	128-131 132-135 136-137 138-139 140-141 142-143 144-145 146-147 148-149 150-151 152-153 154-155 156-157 158-159 160-161 162-163 164-165 166-167 168-169 170-171 172-173 174-175 176-177 178-179 180-181 182-183 184-185 186-187 188-189 190-191 192-193 194-195 196-197 198-199 200-201 202-203 204-205 206-207 208-209 210-211 212-213 214-215 216-217 218-219 220-221 222-223 224-225 226-227 228-229 230-231 232-233 234-235 236-237 238-239 240-241 242-243 244-245 246-247 248-249 250-251 252-253 254-255	136-143	144-151 148-151 152-155 156-159	160-167 164-167 168-171 172-175 176-179 180-183 184-187 188-191 192-195 196-199 200-203 204-207 208-211 212-215 216-219 220-223 224-227 228-231 232-235 236-239 240-243 244-247 248-251 252-255	
									144-159	160-175 168-175 176-183 184-191	192-199 200-207 208-215 216-223	224-231 232-239 240-247 248-255		
			160-191					176-191	192-223	224-255				
			176-191				192-207	192-223	224-255					
			192-255				192-223	192-207	192-207	192-199	192-195 196-199 200-203 204-207 208-211 212-215 216-219 220-223 224-227 228-231 232-235 236-239 240-243 244-247 248-251 252-255	200-207	208-215 216-223	224-231 232-239 240-247 248-255
										208-223	224-231 232-239 240-247 248-255			
						224-239			240-247 248-255					
						240-255		248-255						

# VLSM

with

## Class A and B Addresses

### Sample Problem 38

#### Part 3 of 4

Client #7 has a total of 524,288 addresses. Use the **Class B** address chart to break down the sub-subnetwork addresses for their different clients. At this stage of this problem you are creating sub-subnets in the third or fourth octet of the IP address.

**Hint:** Another way to look at this problem is to see that with the second octet range of 104 to 111 you have access to 8 groups of 65,536 addresses or 8 Class B VLSM charts.

ISP Addresses 75.104.0.0 to 75.111.255.255

Customer Name	Number of Addresses	Address Range	CIDR
Office #1	60,000		
Office #2	45,000		
Office #3	30,000		
Office #4	24,000		
Office #5	15,000		
Office #6	10,000		
Office #7	8,000		
Office #8	2,000		
Office #9	1,000		



# Class B Addresses

## VLSM Chart 16-23 Bits (3rd octet)

<b>/16</b> 255.255.0.0 65,536 Hosts	<b>/17</b> 255.255.128.0 32,768 Hosts	<b>/18</b> 255.255.192.0 16,384 Hosts	<b>/19</b> 255.255.224.0 8,192 Hosts	<b>/20</b> 255.255.240.0 4,096 Hosts	<b>/21</b> 255.255.248.0 2,048 Hosts	<b>/22</b> 255.255.252.0 1,024 Hosts	<b>/23</b> 255.255.254.0 512 Hosts			
0 - 255	0-127	0-63	0-31	0-15	0-7	0-3 4-7	0-1 2-3 4-5 6-7 8-9 10-11 12-13 14-15 16-17 18-19 20-21 22-23 24-25 26-27 28-29 30-31			
				16-31	8-15	8-11 12-15 16-19 20-23 24-27 28-31	32-33 34-35 36-37 38-39 40-41 42-43 44-45 46-47 48-49 50-51 52-53 54-55 56-57 58-59 60-61 62-63 64-65 66-67 68-69 70-71 72-73 74-75 76-77 78-79 80-81 82-83 84-85 86-87 88-89 90-91 92-93 94-95 96-97 98-99 100-101 102-103 104-105 106-107 108-109 110-111 112-113 114-115 116-117 118-119 120-121 122-123 124-125 126-127 128-129 130-131 132-133 134-135 136-137 138-139 140-141 142-143 144-145 146-147 148-149 150-151 152-153 154-155 156-157 158-159 160-161 162-163 164-165 166-167 168-169 170-171 172-173 174-175 176-177 178-179 180-181 182-183 184-185 186-187 188-189 190-191 192-193 194-195 196-197 198-199 200-201 202-203 204-205 206-207 208-209 210-211 212-213 214-215 216-217 218-219 220-221 222-223 224-225 226-227 228-229 230-231 232-233 234-235 236-237 238-239 240-241 242-243 244-245 246-247 248-249 250-251 252-253 254-255			
				32-47	32-39 40-47	32-35 36-39 40-43 44-47 48-49	48-63	48-55 56-63	48-51 52-55 56-59 60-63	
				64-95	64-71 72-79	64-67 68-71 72-75 76-79 80-83 84-87 88-91 92-95 96-99	80-95	80-87 88-95	88-91 92-95 96-99	
				96-127	96-103 104-111 112-119 120-127	96-103 104-107 108-111 112-113 116-119 120-123 124-127	128-143	128-135 136-143	128-131 132-135 136-139 140-143 144-145 146-147 148-149 150-151 152-153 154-155 156-157 158-159 160-161 162-163 164-165 166-167 168-169 170-171 172-173 174-175 176-177 178-179 180-181 182-183 184-185 186-187 188-191 192-193 194-195 196-199 200-201 202-203 204-205 206-207 208-209 210-211 212-213 214-215 216-217 218-219 220-221 222-223 224-225 226-227 228-229 230-231 232-233 234-235 236-237 238-239 240-241 242-243 244-245 246-247 248-249 250-251 252-253 254-255	
				128-255	128-191	128-159	128-143	128-135 136-143	128-131 132-135 136-139 140-143	144-151 152-155 156-159
							144-159	144-151 152-155 156-159	160-167 164-167 168-171 172-175 176-179 180-183 184-191	
			160-191				160-167 168-175	160-163 164-167 168-171 172-175 176-179		
			176-191				176-183 184-191	180-183 184-187 188-191		
			192-207				192-199 200-207	192-195 196-199 200-203 204-207		
			192-223				208-215 216-223	208-211 212-215 216-219 220-223		
			224-239				224-231 232-239	224-227 228-231 232-235 236-239		
			240-255			240-247 248-255	240-243 244-247 248-251 252-255			

# VLSM

with

## Class A and B Addresses

### Sample Problem 38

#### Part 4 of 4

Office #7 from part 3 of 4 has a total of 8,192 addresses. Use the **Class B** address chart to break down the sub-subnetwork addresses for the different branch offices. At this stage of this problem you are creating sub-subnets in the third octet of the IP address.

**Hint:** Remember that the range of this problem is between 128 and 159 in the third octet. Your subnetting will start in the middle of the chart not at the top for this range.

ISP Addresses 75.107.128.0 to 75.107.159.255

Customer Name	Number of Addresses	Address Range	CIDR
Branch #1	4,000		
Branch #2	2,000		
Branch #3	1,000		
Branch #4	500		
Branch #5	450		

# Class B Addresses

## VLSM Chart 16-23 Bits (3rd octet)

/16 255.255.0.0 65,536 Hosts	/17 255.255.128.0 32,768 Hosts	/18 255.255.192.0 16,384 Hosts	/19 255.255.224.0 8,192 Hosts	/20 255.255.240.0 4,096 Hosts	/21 255.255.248.0 2,048 Hosts	/22 255.255.252.0 1,024 Hosts	/23 255.255.254.0 512 Hosts		
0 - 255	0-127	0-63	0-31	0-15	0-7	0-3	0-1		
					8-15	4-7	2-3		
				16-31	16-23	8-11	4-5		
					24-31	12-15	6-7		
					32-47	32-39	16-19	8-9	
						40-47	20-23	10-11	
			48-63			48-55	24-27	12-13	
						56-63	28-31	14-15	
				64-127		64-95	64-71	30-31	16-17
							80-95	32-35	18-19
					96-127		96-103	36-39	20-21
							104-111	40-43	22-23
		128-191	128-143				112-119	44-45	24-25
							144-151	46-47	26-27
						176-191	48-49	28-29	
			192-255			192-207	180-183	50-51	30-31
					208-215		52-55	32-33	
					240-247		54-55	34-35	
		244-255			224-231	56-57	36-37		
					232-239	58-59	38-39		
				248-255	60-63	40-41			
		128-255	128-191	160-191	128-143	64-71	64-67	64-65	
						144-151	68-71	66-67	
					176-191	72-79	72-75	68-69	
	184-191					76-79	70-71		
	192-255				192-223	160-175	80-83	72-73	
						200-207	84-87	74-75	
			208-215	88-91		76-77			
			224-255	224-231	92-95	80-81	78-79		
				232-239	96-99	82-83	80-81		
				240-247	100-103	84-85	82-83		
	128-255		128-191	160-191	128-143	88-95	88-91	86-87	
						144-151	92-95	88-89	
		176-191			104-111	96-99	90-91	88-89	
					184-191	100-103	92-93	90-91	
		192-255			192-223	160-175	104-107	94-95	
						200-207	108-111	96-97	
			208-215	112-115		98-99			
			224-255	224-231	116-119	102-103	98-99		
				232-239	120-123	104-105	100-101		
				240-247	124-127	106-107	102-103		
		128-255	128-191	160-191	128-143	120-127	124-127	108-109	
						144-151	128-131	110-111	
	176-191				136-143	132-135	112-113	110-111	
					184-191	136-139	114-115	112-113	
	192-255				192-223	160-175	140-143	116-117	
						200-207	144-147	118-119	
			208-215	148-151		120-121			
			224-255	224-231	152-155	148-149	122-123		
				232-239	156-159	150-151	124-125		
				240-247	160-163	152-153	126-127		
	128-255		128-191	160-191	128-143	164-167	164-167	128-129	
184-191						168-171	130-131		
176-191		172-175			172-175	132-133	130-131		
		184-191			176-179	134-135	132-133		
192-255		192-223			160-175	180-183	136-137		
					200-207	184-187	138-139		
			208-215	188-191	140-141				
		224-255	224-231	192-195	142-143	144-145			
			232-239	196-199	144-147	146-147			
			240-247	200-203	148-149	148-149			
128-255		128-191	160-191	128-143	204-207	204-207	150-151		
					208-215	208-211	152-153		
	176-191			216-223	212-215	154-155	152-153		
				184-191	216-219	156-157	154-155		
	192-255			192-223	224-231	220-223	158-159		
					232-239	224-227	160-161		
		240-247	228-231		162-163				
		224-255	224-231	232-235	164-165	166-167			
			232-239	236-239	168-169	168-169			
			240-247	240-243	170-171	170-171			
	128-255	128-191	160-191	128-143	244-247	244-247	172-173		
					248-251	248-251	174-175		
176-191				252-255	252-255	176-177	174-175		
				252-255	252-255	178-179	176-177		
192-255				192-223	224-231	244-247	180-181		
					232-239	248-251	182-183		
		240-247	252-255		184-185				
		224-255	224-231	252-255	186-187	184-185			
			232-239	252-255	188-189	186-187			
			240-247	252-255	190-191	188-189			



# Reference Charts and Support Materials

**Class A Addresses**  
VLSM Chart 8-15 Bits (2nd octet)

Class A	Subnet Mask	Subnet	Hosts	Subnet Mask	Subnet	Hosts	Subnet Mask	Subnet	Hosts	Subnet Mask	Subnet	Hosts	Subnet Mask	Subnet	Hosts			
10.0.0.0	255.255.0.0	10.0.0.0	16,777,216	255.255.255.0	10.0.0.0	254	255.255.255.0	10.0.0.0	254	255.255.255.0	10.0.0.0	254	255.255.255.0	10.0.0.0	254			
		10.0.255.0	254		10.0.255.0	254		10.0.255.0	254									
	255.255.252.0	10.0.0.0	4,194,304	255.255.255.0	10.0.0.0	254	255.255.255.0	10.0.0.0	254	255.255.255.0	10.0.0.0	254	255.255.255.0	10.0.0.0	254	255.255.255.0	10.0.0.0	254
		10.0.4.0	4,194,304		10.0.4.0	254		10.0.4.0	254		10.0.4.0	254						
		10.0.8.0	4,194,304		10.0.8.0	254		10.0.8.0	254		10.0.8.0	254		10.0.8.0	254			
		10.0.12.0	4,194,304		10.0.12.0	254		10.0.12.0	254		10.0.12.0	254		10.0.12.0	254			
	255.255.254.0	10.0.0.0	2,097,152	255.255.255.0	10.0.0.0	254	255.255.255.0	10.0.0.0	254	255.255.255.0	10.0.0.0	254	255.255.255.0	10.0.0.0	254	255.255.255.0	10.0.0.0	254
		10.0.2.0	2,097,152		10.0.2.0	254		10.0.2.0	254		10.0.2.0	254						
		10.0.4.0	2,097,152		10.0.4.0	254		10.0.4.0	254		10.0.4.0	254		10.0.4.0	254			
		10.0.6.0	2,097,152		10.0.6.0	254		10.0.6.0	254		10.0.6.0	254		10.0.6.0	254			
		10.0.8.0	2,097,152		10.0.8.0	254		10.0.8.0	254		10.0.8.0	254		10.0.8.0	254			
		10.0.10.0	2,097,152		10.0.10.0	254		10.0.10.0	254		10.0.10.0	254		10.0.10.0	254			
		10.0.12.0	2,097,152		10.0.12.0	254		10.0.12.0	254		10.0.12.0	254		10.0.12.0	254			
		10.0.14.0	2,097,152		10.0.14.0	254		10.0.14.0	254		10.0.14.0	254		10.0.14.0	254			

**Class B Addresses**  
VLSM Chart 16-23 Bits (3rd octet)

Class B	Subnet Mask	Subnet	Hosts	Subnet Mask	Subnet	Hosts	Subnet Mask	Subnet	Hosts	Subnet Mask	Subnet	Hosts	Subnet Mask	Subnet	Hosts			
172.16.0.0	255.255.0.0	172.16.0.0	65,536	255.255.255.0	172.16.0.0	254	255.255.255.0	172.16.0.0	254	255.255.255.0	172.16.0.0	254	255.255.255.0	172.16.0.0	254			
		172.16.255.0	254		172.16.255.0	254		172.16.255.0	254		172.16.255.0	254						
	255.255.252.0	172.16.0.0	16,384	255.255.255.0	172.16.0.0	254	255.255.255.0	172.16.0.0	254	255.255.255.0	172.16.0.0	254	255.255.255.0	172.16.0.0	254	255.255.255.0	172.16.0.0	254
		172.16.4.0	16,384		172.16.4.0	254		172.16.4.0	254		172.16.4.0	254						
		172.16.8.0	16,384		172.16.8.0	254		172.16.8.0	254		172.16.8.0	254		172.16.8.0	254			
		172.16.12.0	16,384		172.16.12.0	254		172.16.12.0	254		172.16.12.0	254		172.16.12.0	254			
	255.255.254.0	172.16.0.0	8,192	255.255.255.0	172.16.0.0	254	255.255.255.0	172.16.0.0	254	255.255.255.0	172.16.0.0	254	255.255.255.0	172.16.0.0	254	255.255.255.0	172.16.0.0	254
		172.16.2.0	8,192		172.16.2.0	254		172.16.2.0	254		172.16.2.0	254						
		172.16.4.0	8,192		172.16.4.0	254		172.16.4.0	254		172.16.4.0	254		172.16.4.0	254			
		172.16.6.0	8,192		172.16.6.0	254		172.16.6.0	254		172.16.6.0	254		172.16.6.0	254			
		172.16.8.0	8,192		172.16.8.0	254		172.16.8.0	254		172.16.8.0	254		172.16.8.0	254			
		172.16.10.0	8,192		172.16.10.0	254		172.16.10.0	254		172.16.10.0	254		172.16.10.0	254			
		172.16.12.0	8,192		172.16.12.0	254		172.16.12.0	254		172.16.12.0	254		172.16.12.0	254			
		172.16.14.0	8,192		172.16.14.0	254		172.16.14.0	254		172.16.14.0	254		172.16.14.0	254			

**Class C Addresses**  
VLSM Chart 24-30 Bits (4th octet)

Class C	Subnet Mask	Subnet	Hosts	Subnet Mask	Subnet	Hosts	Subnet Mask	Subnet	Hosts	Subnet Mask	Subnet	Hosts	Subnet Mask	Subnet	Hosts			
192.168.0.0	255.255.255.0	192.168.0.0	254	255.255.255.0	192.168.0.0	254	255.255.255.0	192.168.0.0	254	255.255.255.0	192.168.0.0	254	255.255.255.0	192.168.0.0	254			
		192.168.255.0	254		192.168.255.0	254		192.168.255.0	254		192.168.255.0	254						
	255.255.255.240	192.168.0.0	62	255.255.255.255	192.168.0.0	254	255.255.255.255	192.168.0.0	254	255.255.255.255	192.168.0.0	254	255.255.255.255	192.168.0.0	254	255.255.255.255	192.168.0.0	254
		192.168.4.0	62		192.168.4.0	254		192.168.4.0	254		192.168.4.0	254						
		192.168.8.0	62		192.168.8.0	254		192.168.8.0	254		192.168.8.0	254		192.168.8.0	254			
		192.168.12.0	62		192.168.12.0	254		192.168.12.0	254		192.168.12.0	254		192.168.12.0	254			
	255.255.255.248	192.168.0.0	30	255.255.255.255	192.168.0.0	254	255.255.255.255	192.168.0.0	254	255.255.255.255	192.168.0.0	254	255.255.255.255	192.168.0.0	254	255.255.255.255	192.168.0.0	254
		192.168.1.0	30		192.168.1.0	254		192.168.1.0	254		192.168.1.0	254						
		192.168.2.0	30		192.168.2.0	254		192.168.2.0	254		192.168.2.0	254		192.168.2.0	254			
		192.168.3.0	30		192.168.3.0	254		192.168.3.0	254		192.168.3.0	254		192.168.3.0	254			
		192.168.4.0	30		192.168.4.0	254		192.168.4.0	254		192.168.4.0	254		192.168.4.0	254			
		192.168.5.0	30		192.168.5.0	254		192.168.5.0	254		192.168.5.0	254		192.168.5.0	254			
		192.168.6.0	30		192.168.6.0	254		192.168.6.0	254		192.168.6.0	254		192.168.6.0	254			
		192.168.7.0	30		192.168.7.0	254		192.168.7.0	254		192.168.7.0	254		192.168.7.0	254			

# Class A Addresses

## VLSM Chart 8-15 Bits (2nd octet)

/8 255.0.0.0 16,777,216 Hosts	/9 255.128.0.0 8,388,608 Hosts	/10 255.192.0.0 4,194,304 Hosts	/11 255.224.0.0 2,097,152 Hosts	/12 255.240.0.0 1,048,576 Hosts	/13 255.248.0.0 524,288 Hosts	/14 255.252.0.0 262,144 Hosts	/15 255.254.0.0 131,072 Hosts
0 - 255	0-127	0-63	0-31	0-15	0-7	0-3	0-1
					8-15	4-7	2-3
				16-31	16-23	8-11	4-5
					24-31	12-15	6-7
					32-47	16-19	8-9
						20-23	10-11
			32-63	48-63	24-27	14-15	
					32-39	16-17	
					40-47	18-19	
				64-79	48-55	20-21	
					56-63	22-23	
					64-71	24-25	
		64-127	80-95	80-87	26-27		
				88-95	28-29		
				96-111	96-103	30-31	
					104-111	32-33	
			96-127	128-143	112-119	34-35	
					120-127	36-37	
				144-159	128-135	38-39	
					136-143	40-41	
		128-191	160-191	144-151	42-43		
				152-159	44-45		
				176-191	160-167	46-47	
					168-175	48-49	
	192-207			176-183	50-51		
				180-183	52-53		
	192-223		208-223	184-191	54-55		
				216-223	192-199	56-57	
					200-207	58-59	
			224-239	208-215	60-61		
				216-217	62-63		
				224-231	64-65		
	128-255	192-255	240-255	224-227	66-67		
				232-239	68-69		
			240-247	228-231	70-71		
				236-237	72-73		
		240-255	240-247	240-247	74-75		
				248-251	76-77		
			248-255	244-247	78-79		
				252-255	80-81		

# Class B Addresses

## VLSM Chart 16-23 Bits (3rd octet)

<b>/16</b> 255.255.0.0 65,536 Hosts	<b>/17</b> 255.255.128.0 32,768 Hosts	<b>/18</b> 255.255.192.0 16,384 Hosts	<b>/19</b> 255.255.224.0 8,192 Hosts	<b>/20</b> 255.255.240.0 4,096 Hosts	<b>/21</b> 255.255.248.0 2,048 Hosts	<b>/22</b> 255.255.252.0 1,024 Hosts	<b>/23</b> 255.255.254.0 512 Hosts		
0 - 255	0-127	0-63	0-31	0-15	0-7	0-3	0-1		
					8-15	4-7	2-3		
				16-31	16-23	8-11	4-5	6-7	
						12-15	6-7	8-9	
					24-31	16-19	10-11	10-11	12-13
							20-23	12-13	14-15
			24-27			16-17	16-17	18-19	
						28-31	18-19	20-21	
			32-63	32-39	32-35	20-21	22-23		
						24-25	24-25		
					40-47	26-27	26-27	28-29	
				48-55		30-31	30-31	32-33	
		32-33				32-33	34-35		
		64-95		64-71	48-51	34-35	34-35		
			52-55			36-37			
			72-79		40-41	36-37	38-39		
				44-45	40-41	42-43			
				46-47	42-43	44-45			
			96-127	80-87	48-51	44-45	44-45		
		52-55				46-47			
		88-95			48-49	48-49	50-51		
				50-51	50-51	52-53			
				52-53	52-53	54-55			
		128-159		128-143	64-67	54-55	54-55		
	68-71		56-57						
	136-143		68-69		56-57	58-59			
			140-143		60-61	60-61			
	144-159		144-151	62-63	62-63	64-65			
				148-151	64-65	66-67			
			152-159	66-67	66-67	68-69			
				156-159	68-69	70-71			
	160-191	160-175	68-71	70-71	70-71				
				72-75	72-73				
			168-175	72-73	72-73	74-75			
				172-175	74-75	76-77			
		176-191	176-183	76-77	76-77	78-79			
				180-183	80-81				
			184-191	80-81	80-81	82-83			
				188-191	82-83	84-85			
	192-255	192-223	192-199	84-85	84-85				
				196-199	86-87				
				200-203	86-87	88-89			
			208-223	192-207	88-89	88-89	90-91		
					200-207	90-91	92-93		
				208-215	196-197	92-93	92-93		
		224-255	208-215	196-199	94-95	94-95			
					200-203	96-97			
				216-223	204-207	96-97	96-97	98-99	
			208-211			98-99	100-101		
			224-239		208-211	100-101	100-101	102-103	
				212-215		102-103	104-105		
	232-239	216-217		104-105	104-105	106-107			
220-223			106-107	108-109					
240-247		224-227	108-109	108-109	110-111				
	228-231		110-111	112-113					
	248-255	232-235	112-113	112-113	114-115				
236-239			114-115	116-117					
252-255		240-241	116-117	116-117	118-119				
	244-247		118-119	120-121					

# Class C Addresses

## VLSM Chart 24-30 Bits (4th octet)

<b>/24</b> 255.255.255.0 256 Hosts	<b>/25</b> 255.255.255.128 128 Hosts	<b>/26</b> 255.255.255.192 64 Hosts	<b>/27</b> 255.255.255.224 32 Hosts	<b>/28</b> 255.255.255.240 16 Hosts	<b>/29</b> 255.255.255.248 8 Hosts	<b>/30</b> 255.255.255.252 4 Hosts
0 - 255	0-127	0-63	0-31	0-15	0-7	0-3
						4-7
					8-15	8-11
						12-15
			16-31	16-23	16-19	
					20-23	
				24-31	24-27	
					28-31	
		32-63	32-47	32-39	32-35	
					36-39	
				40-47	40-43	
					44-47	
			48-63	48-55	48-51	
					52-55	
				56-63	56-59	
					60-63	
	64-127	64-95	64-79	64-71	64-67	
					68-71	
				72-79	72-75	
					76-79	
			80-95	80-87	80-83	
					84-87	
				88-95	88-91	
					92-95	
		96-127	96-111	96-103	96-99	
					100-103	
				104-111	104-107	
					108-111	
			112-127	112-119	112-115	
					116-119	
				120-127	120-123	
					124-127	
128-255	128-191	128-159	128-143	128-131		
				132-135		
			136-143	136-139		
				140-143		
		144-159	144-151	144-147		
				148-151		
			152-159	152-155		
				156-159		
	160-191	160-167	160-163			
			164-167			
		168-175	168-171			
			172-175			
	176-191	176-183	176-179	176-179		
				180-183		
			184-191	184-187		
				188-191		
192-207		192-199	192-195			
			196-199			
		200-207	200-203			
			204-207			
192-223	208-215	208-211	208-211			
			212-215			
	216-223	216-219	216-219			
			220-223			
192-255	224-239	224-231	224-227			
			228-231			
		232-239	232-235			
			236-239			
	224-255	240-247	240-243			
			244-247			
		248-255	248-251			
			252-255			



### Class A Addressing Guide

CIDR	# of Bits Borrowed	Subnet Mask	Total # of Subnets	Total # of Hosts	Usable # of Hosts
/8	0	255.0.0.0	1	16,777,216	16,777,214
/9	1	255.128.0.0	2	8,388,608	8,388,606
/10	2	255.192.0.0	4	4,194,304	4,194,302
/11	3	255.224.0.0	8	2,097,152	2,097,150
/12	4	255.240.0.0	16	1,048,576	1,048,574
/13	5	255.248.0.0	32	524,288	524,286
/14	6	255.252.0.0	64	262,144	262,142
/15	7	255.254.0.0	128	131,072	131,070
/16	8	255.255.0.0	256	65,536	65,534
/17	9	255.255.128.0	512	32,768	32,766
/18	10	255.255.192.0	1,024	16,384	16,382
/19	11	255.255.224.0	2,048	8,192	8,190
/20	12	255.255.240.0	4,096	4,096	4,094
/21	13	255.255.248.0	8,192	2,048	2,046
/22	14	255.255.252.0	16,384	1,024	1,022
/23	15	255.255.254.0	32,768	512	510
/24	16	255.255.255.0	65,536	256	254
/25	17	255.255.255.128	131,072	128	126
/26	18	255.255.255.192	262,144	64	62
/27	19	255.255.255.224	524,288	32	30
/28	20	255.255.255.240	1,048,576	16	14
/29	21	255.255.255.248	2,097,152	8	6
/30	22	255.255.255.252	4,194,304	4	2

### Class B Addressing Guide

CIDR	# of Bits Borrowed	Subnet Mask	Total # of Subnets	Total # of Hosts	Usable # of Hosts
/16	0	255.255.0.0	1	65,536	65,534
/17	1	255.255.128.0	2	32,768	32,766
/18	2	255.255.192.0	4	16,384	16,382
/19	3	255.255.224.0	8	8,192	8,190
/20	4	255.255.240.0	16	4,096	4,094
/21	5	255.255.248.0	32	2,048	2,046
/22	6	255.255.252.0	64	1,024	1,022
/23	7	255.255.254.0	128	512	510
/24	8	255.255.255.0	256	256	254
/25	9	255.255.255.128	512	128	126
/26	10	255.255.255.192	1,024	64	62
/27	11	255.255.255.224	2,048	32	30
/28	12	255.255.255.240	4,096	16	14
/29	13	255.255.255.248	8,192	8	6
/30	14	255.255.255.252	16,384	4	2

### Class C Addressing Guide

CIDR	# of Bits Borrowed	Subnet Mask	Total # of Subnets	Total # of Hosts	Usable # of Hosts
/24	0	255.255.255.0	1	256	254
/25	1	255.255.255.128	2	128	126
/26	2	255.255.255.192	4	64	62
/27	3	255.255.255.224	8	32	30
/28	4	255.255.255.240	16	16	14
/29	5	255.255.255.248	32	8	6
/30	6	255.255.255.252	64	4	2

