

10.250.1.0
192.168.10.0
172.31.15.0

VLSM
Variable-Length Subnet Mask
IPv4
Workbook
Version 2.3

192.168.10.0

192.168.10.96

192.168.10.126

172.31.15.0

10.250.1.0

Student Name:

IPv4 Address Classes

Class A	1 – 127	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)		

Speciality Address Ranges

Loopback -	Only the single 127.0.0.1 address is used, addresses 127.0.0.0 to 127.255.255.255 are reserved. Any address within this block will loop back to the local host.
Link-Local Addresses -	IPv4 addresses in the address block 169.254.0.0 to 169.254.255.255 (169.254.0.0/16) are designated as link-local addresses.
TEST-NET Addresses -	The address block 192.0.2.0 to 192.0.2.255 (192.0.2.0/24) is set aside for teaching and learning purposes.
Experimental Addresses -	The addresses in the block 240.0.0.0 to 255.255.255.254 are listed as reserved for future use (RFC 3330).

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

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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, Variable Length Subnet Masks.

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 Masks 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

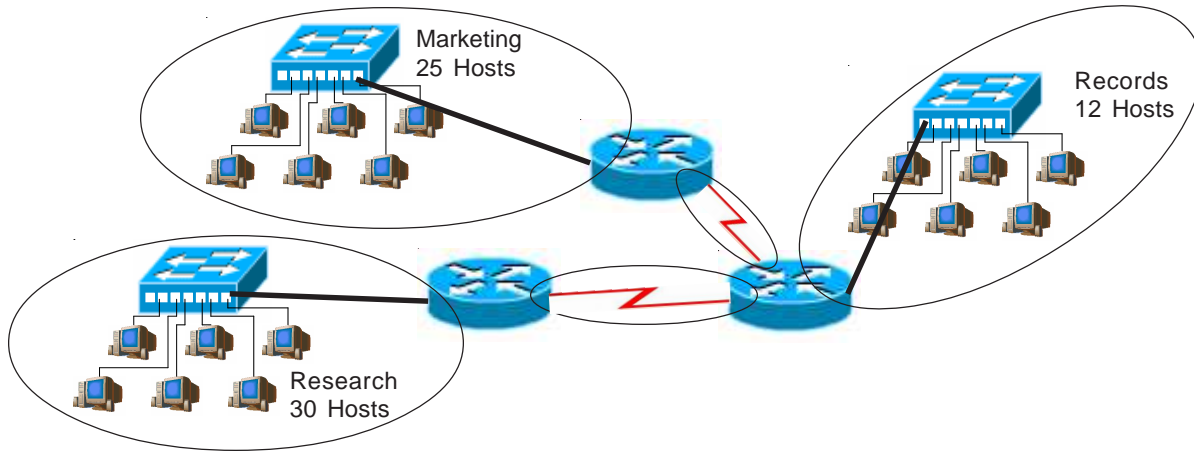
This workbook explores three different methods to figure out sub-subnets: the box method, the circle method, and a VLSM chart.

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.

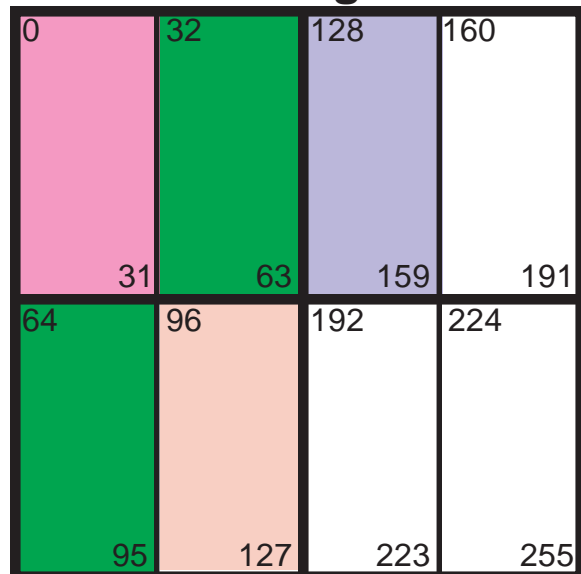
IP Address: 192.168.1.0



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		

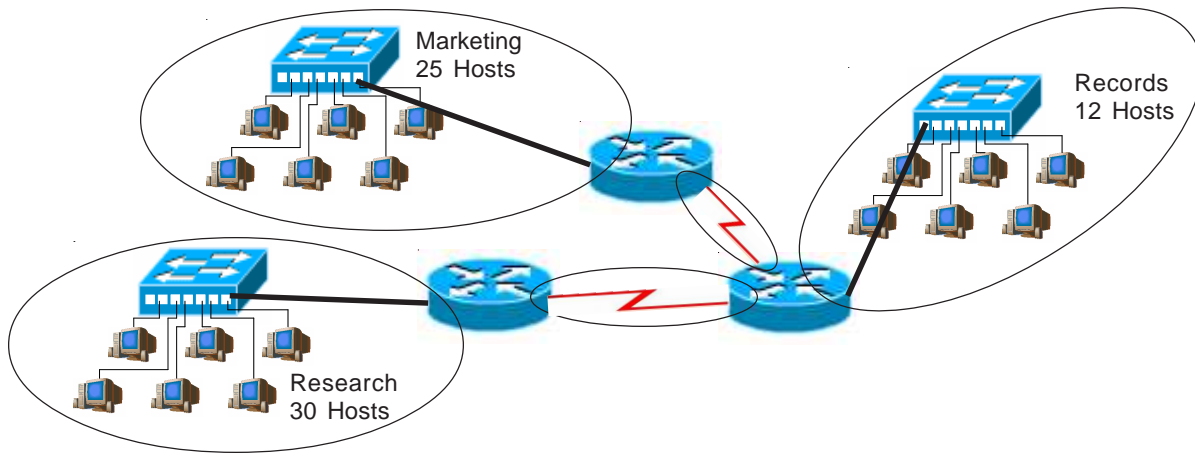


Classless Subnetting Example

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 usable addresses each.

IP Address: 192.168.1.0

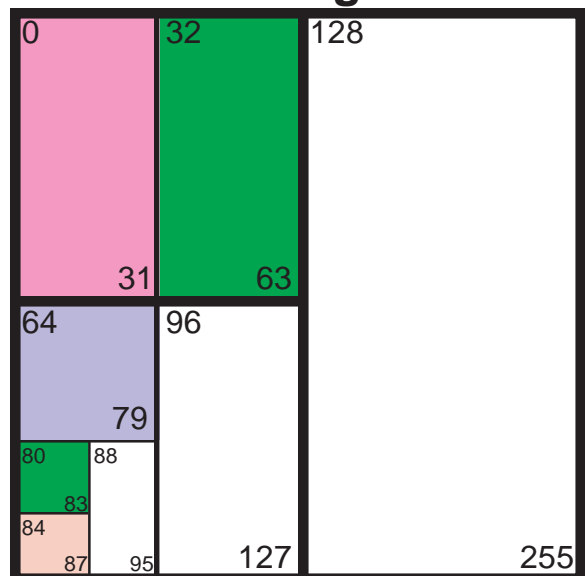


By adjusting the subnet masks you can cut your address usage by almost half in this example. This type of subnetting requires a network protocol which will support it such as: RIP version 2, EIGRP, OSPF, or BGP.

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

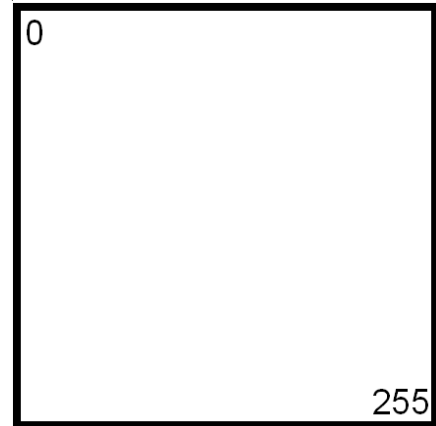


Visualizing Subnets Using The Box Method

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.

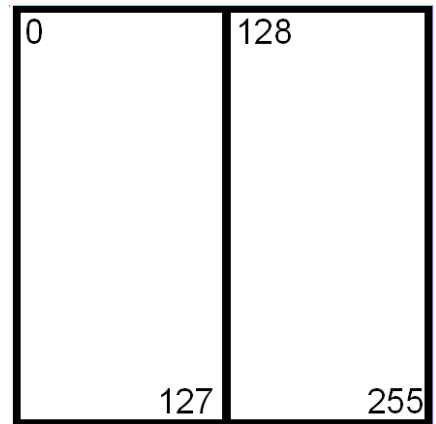
Start with a square. The whole square is a single subnet comprised of 256 addresses.

/24
255.255.255.0
256 Hosts
1 Subnet



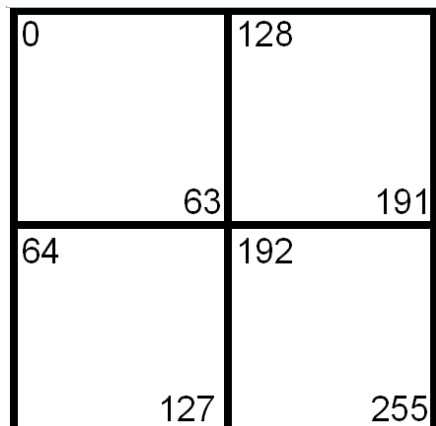
Split the box in half and you get two subnets with 128 addresses.

/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

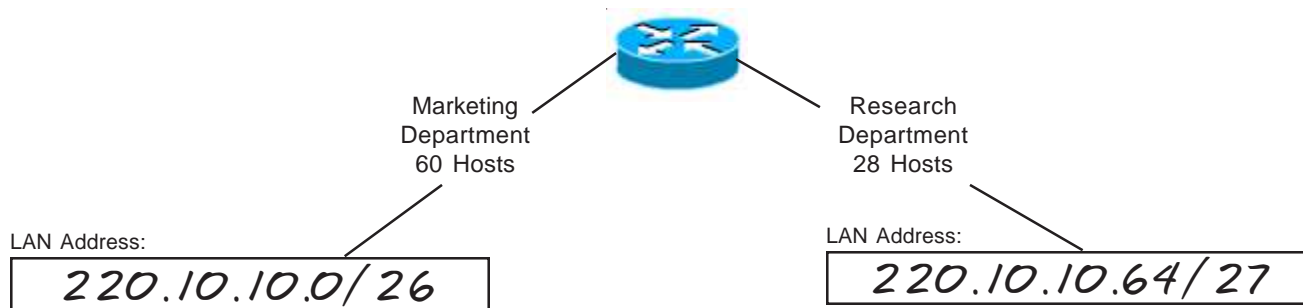
VLSM Addressing

Box Method

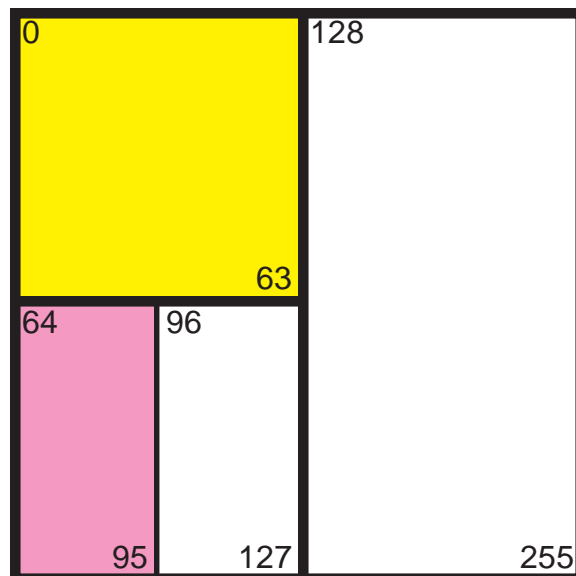
(Sample)

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.



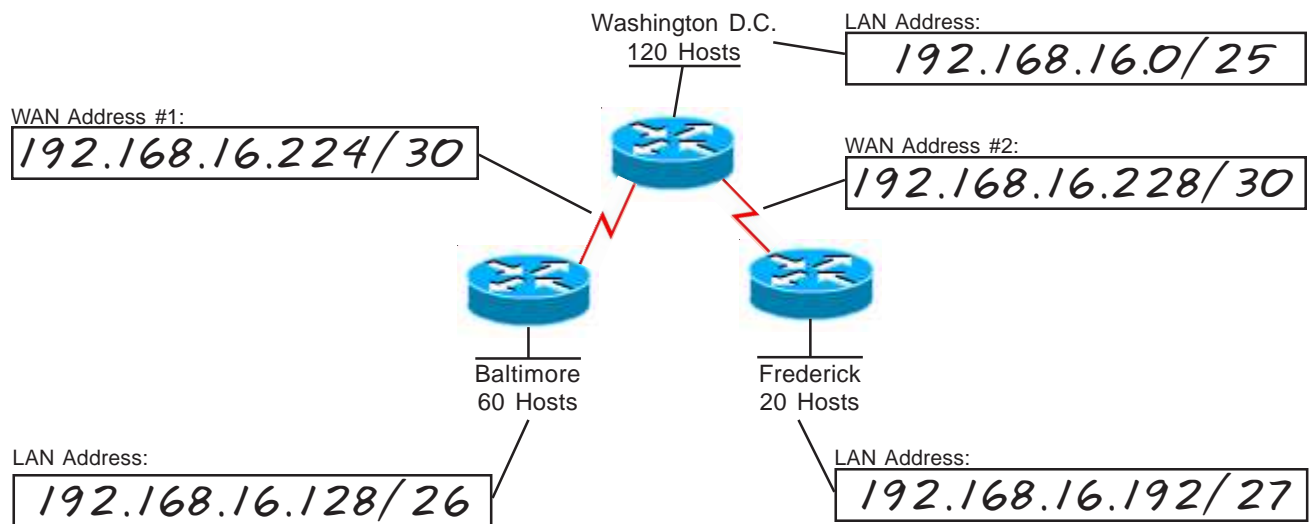
VLSM Addressing

Box Method

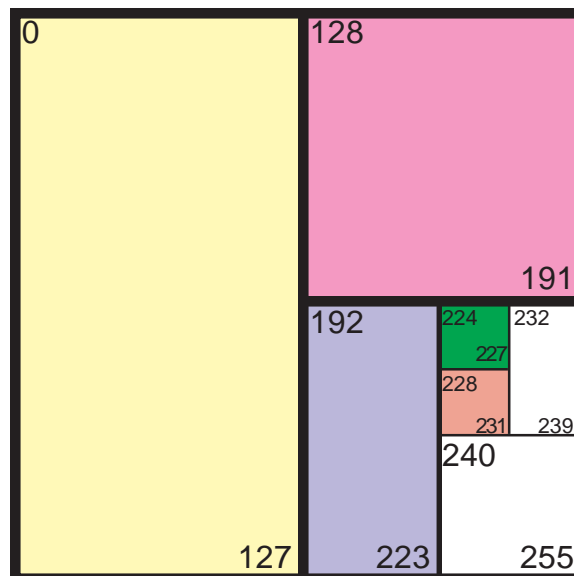
(Sample)

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.

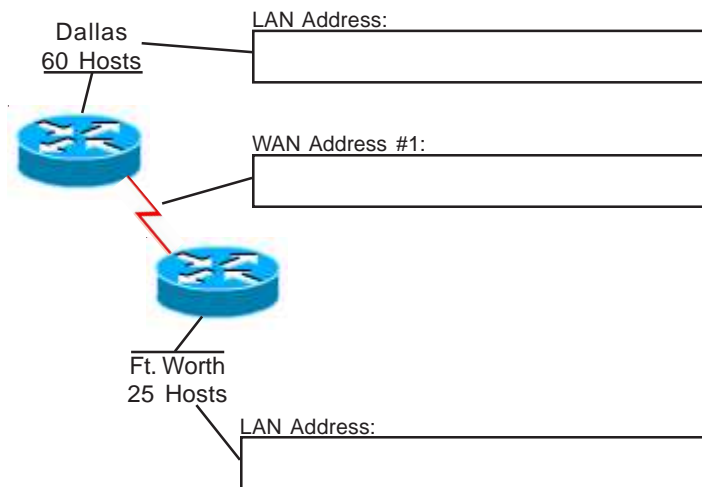


VLSM Addressing

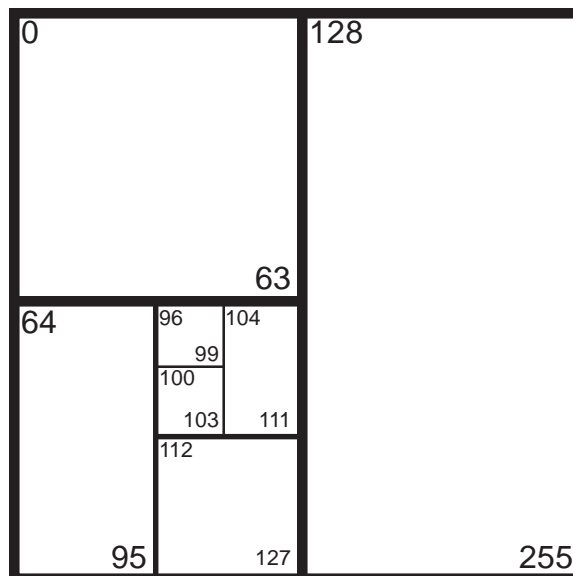
Box Method

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.

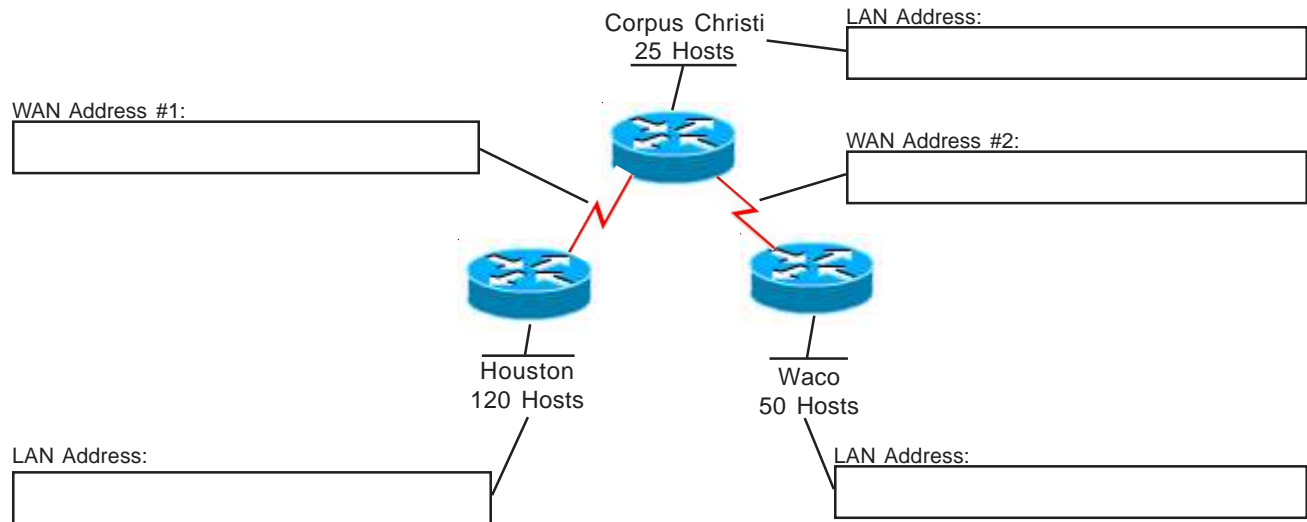


VLSM Addressing

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.

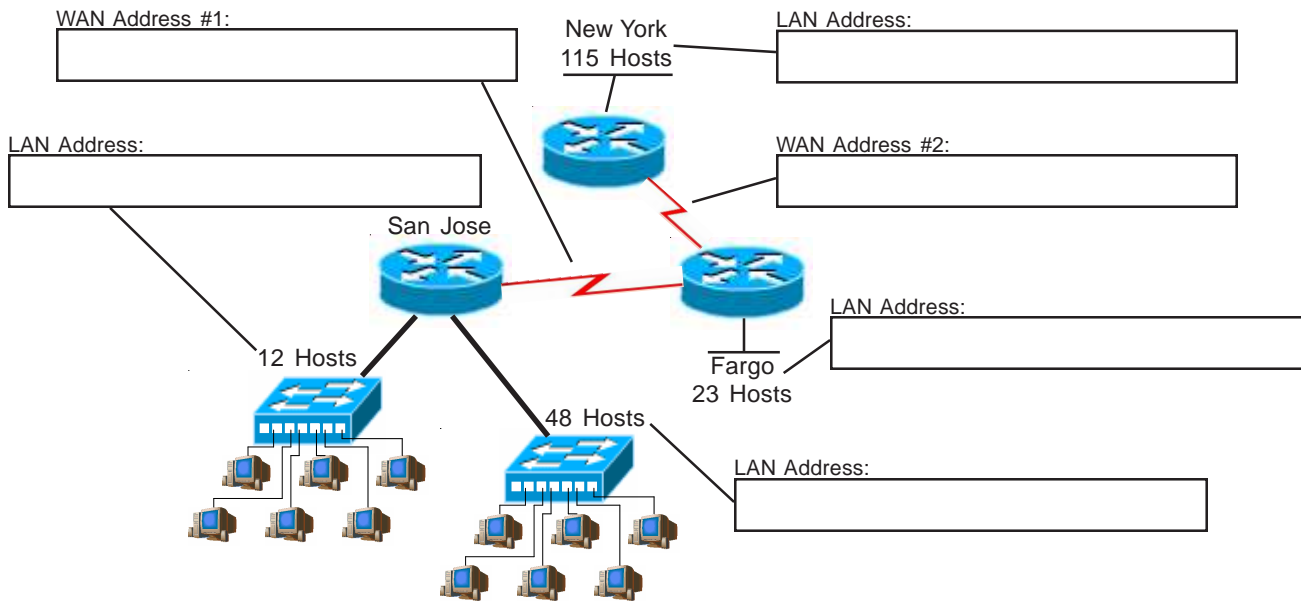
0	8	32	40	128	136	160	168	
	3	11	35	43	131	139	163	171
4	12	36	44	132	140	164	172	
	7	15	39	47	135	143	167	175
16	24	48	56	144	152	176	184	
	19	27	51	59	147	155	179	187
20	28	52	60	148	156	180	188	
	23	31	55	63	151	159	183	191
64	72	96	104	192	200	224	232	
	67	75	99	107	195	203	227	235
68	76	100	108	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.

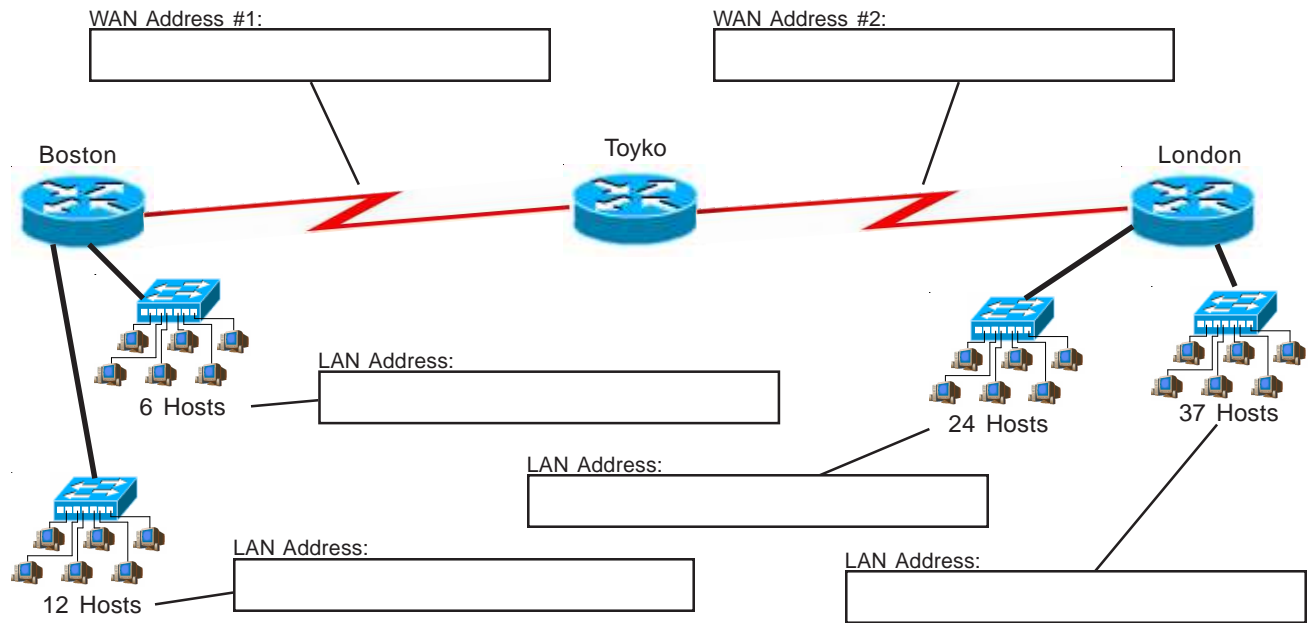
0	8	32	40	128	136	160	168	
	3	11	35	43	131	139	163	171
4	12	36	44	132	140	164	172	
	7	15	39	47	135	143	167	175
16	24	48	56	144	152	176	184	
	19	27	51	59	147	155	179	187
20	28	52	60	148	156	180	188	
	23	31	55	63	151	159	183	191
64	72	96	104	192	200	224	232	
	67	75	99	107	195	203	227	235
68	76	100	108	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.

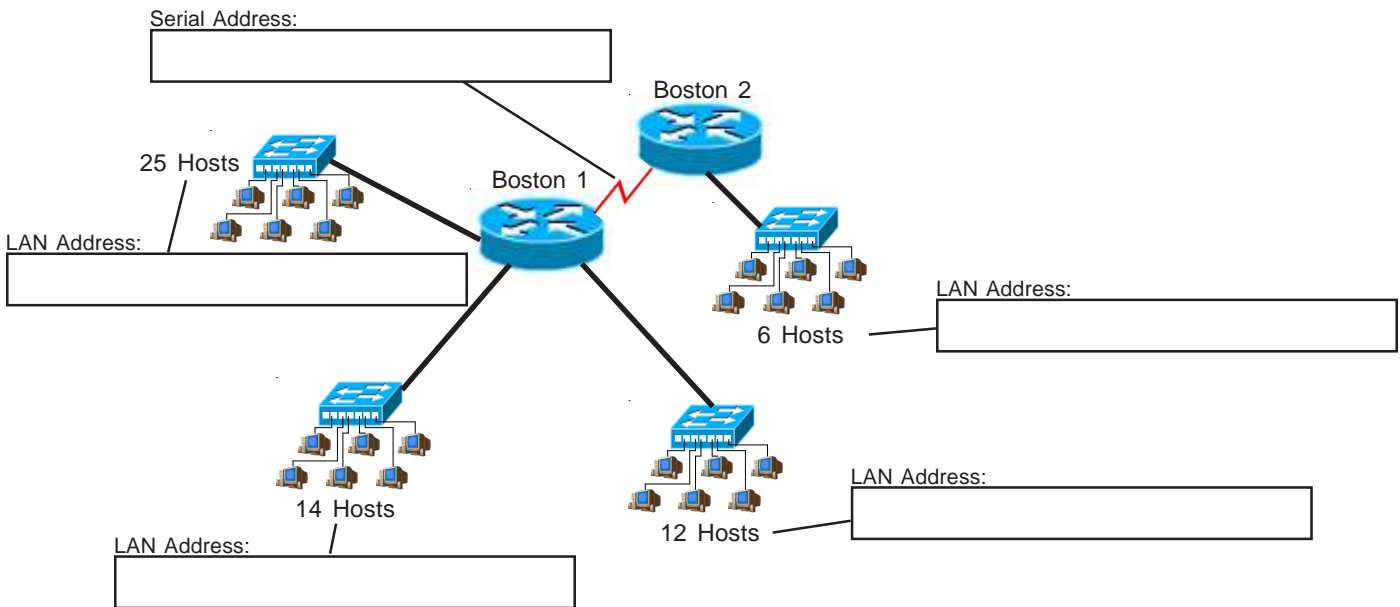
0	32	128	160
	31	63	159
64	96	192	224
	95	127	255

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.

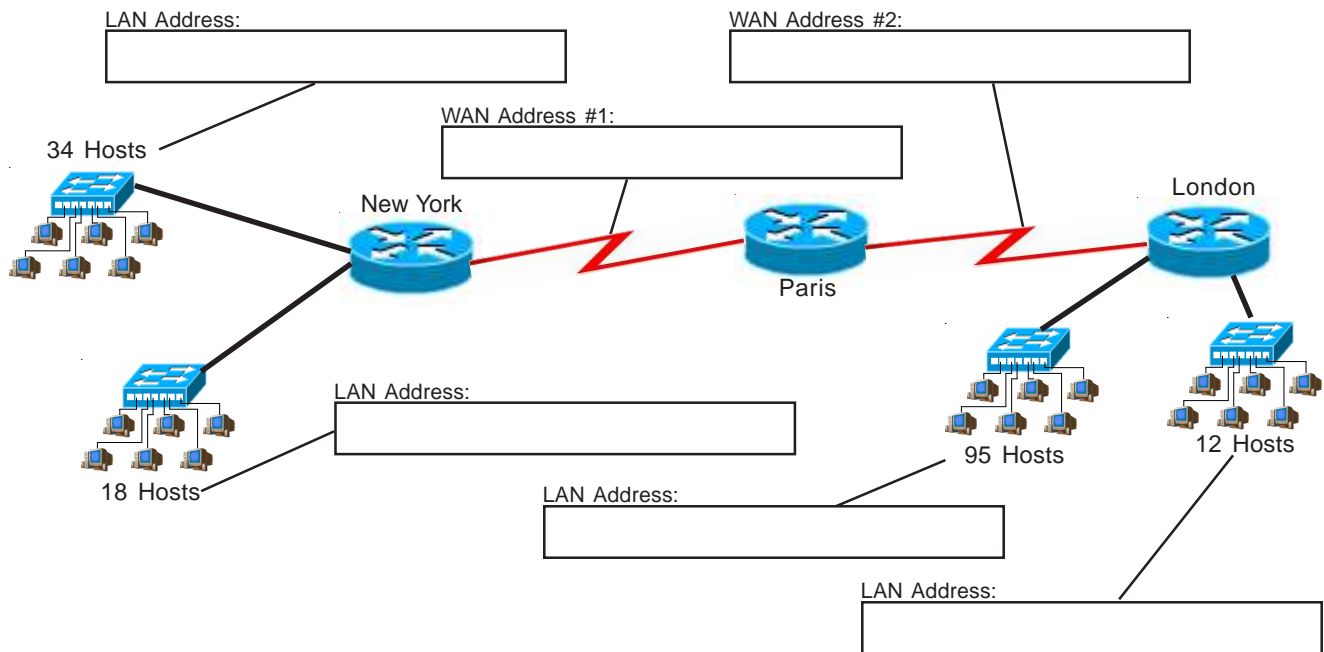
0	128
63	191
64	192
127	255

VLSM Addressing

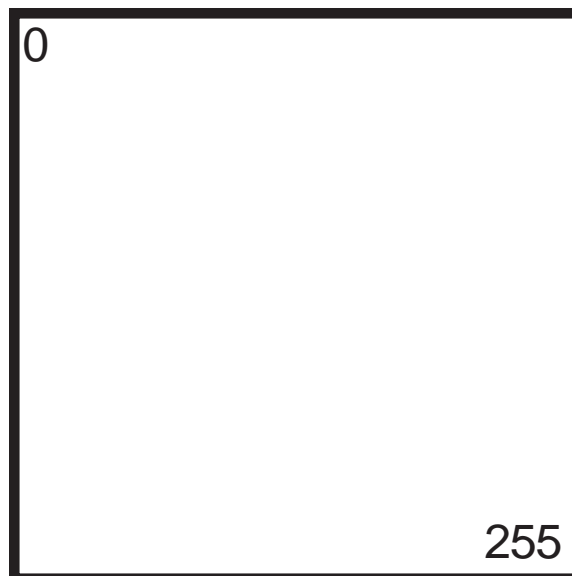
Box Method

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.



Configuring Subnets Using The Numeric Method

The Numeric method extends the technique from the IP Addressing and Subnetting workbook to allow for classless subnetting. Start by listing the needed hosts per subnets from largest to smallest.

Step 1

In this sample the needed host groups are:

- 120 Washington D. C.
- 60 Baltimore
- 20 Frederick
- 2 Serial #1
- 2 Serial #2



Step 2

Lay out the IP address the same way you would in the IP Addressing and Subnetting workbook showing the binary values of the bits, the number of subnets, and the number of hosts.

	256	128	64	32	16	8	4	2	-	Number of Hosts
Number of Subnets	-	2	4	8	16	32	64	128	256	
		128	64	32	16	8	4	2	1	- Binary values
	192.	10	.	10	.	0	0	0	0	0

Step 3

Draw a line allowing for 120 hosts. Using the value of the last bit borrowed or magic number, write in your first range. Then add the subnet address to start the second range.

	120 <i>Hosts</i>									
	256	128	64	32	16	8	4	2	-	Number of Hosts
Number of Subnets	-	2	4	8	16	32	64	128	256	
	(128)	64	32	16	8	4	2	1	-	Binary values
	192.	10	.	10	.	0	0	0	0	0

	<u>Address Ranges</u>			
<u>Hosts</u>	192.168.16.0	to	192.168.16.127	<u>CIDR</u>
120	192.168.16.128	to		/25

Step 4

Draw a second line for the 60 hosts. Use the value of the last bit borrowed or magic number to lay out the second largest subnet. Add the subnet address which will begin the third range.

		<i>120</i>	<i>60</i>										
		<i>Hosts</i>	<i>Hosts</i>										
<i>Number of</i>		256	128	64	32	16	8	4	2	-	<i>Number of</i>		
<i>Subnets</i>	-	2	4	8	16	32	64	128	256		<i>Hosts</i>		
		128	64	32	16	8	4	2	1	-	<i>Binary values</i>		
		192	.10	.10	.0	0	0	0	0	0	0	0	0

<u>Hosts</u>	<u>Address Ranges</u>	<u>CIDR</u>
120	192.168.16.0 to 192.168.16.127	/25
60	192.168.16.128 to 192.168.16.191	/26
	192.168.16.192 to	

Step 5

Continue the same process until all the subnets are accounted for. The CIDR is the total number of bits borrowed for the network and subnetwork portion of the address.

		<i>120</i>	<i>60</i>	<i>20</i>		<i>2</i>							
		<i>Hosts</i>	<i>Hosts</i>	<i>Hosts</i>		<i>Hosts</i>							
<i>Number of</i>		256	128	64	32	16	8	4	2	-	<i>Number of</i>		
<i>Subnets</i>	-	2	4	8	16	32	64	128	256		<i>Hosts</i>		
		128	64	32	16	8	4	2	1	-	<i>Binary values</i>		
		192	.10	.10	.0	0	0	0	0	0	0	0	0

<u>Hosts</u>	<u>Address Ranges</u>	<u>CIDR</u>
120	192.168.16.0 to 192.168.16.127	/25
60	192.168.16.128 to 192.168.16.191	/26
20	192.168.16.192 to 192.168.16.223	/27
2	192.168.16.224 to 192.168.16.227	/30
2	192.168.16.228 to 192.168.16.231	/30

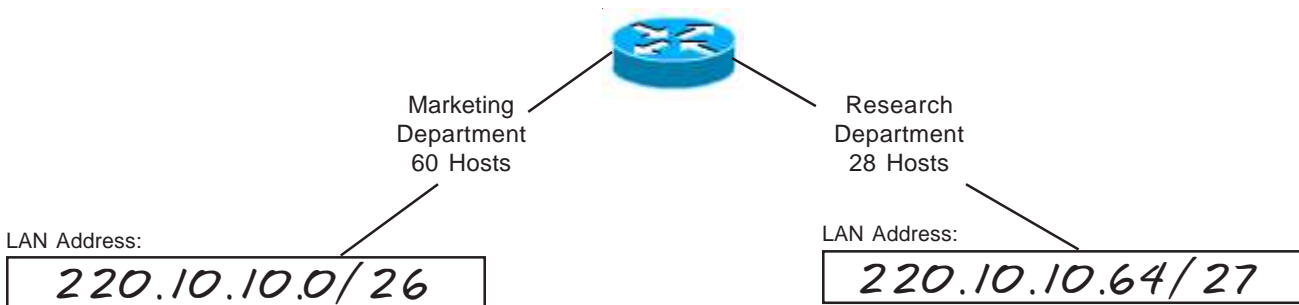
VLSM Addressing

Numeric Method

(Sample)

Problem 9

Using the network diagram and information given create an addressing scheme which utilizes variable-length subnet masks. Layout and show the subnet address and CIDR in the space below. This business will be using the class C address 220.10.10.0. Start with your largest groups first.



Show your work for Problem 9 in the space below.

		<i>60 Hosts</i>		<i>28 Hosts</i>																	
		256	128	64	32	16	8	4	2	-											<i>Number of Hosts</i>
<i>Number of Subnets</i>	-	2	4	8	16	32	64	128	256												
		128	64	32	16	8	4	2	1	-											<i>Binary values</i>
		192	10	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
<hr/>																					
<u><i>Hosts</i></u>		<u><i>Address Ranges</i></u>														<u><i>CIDR</i></u>					
60		220.10.10.0 to 220.10.10.63														/26					
28		220.10.10.64 to 220.10.10.95														/27					

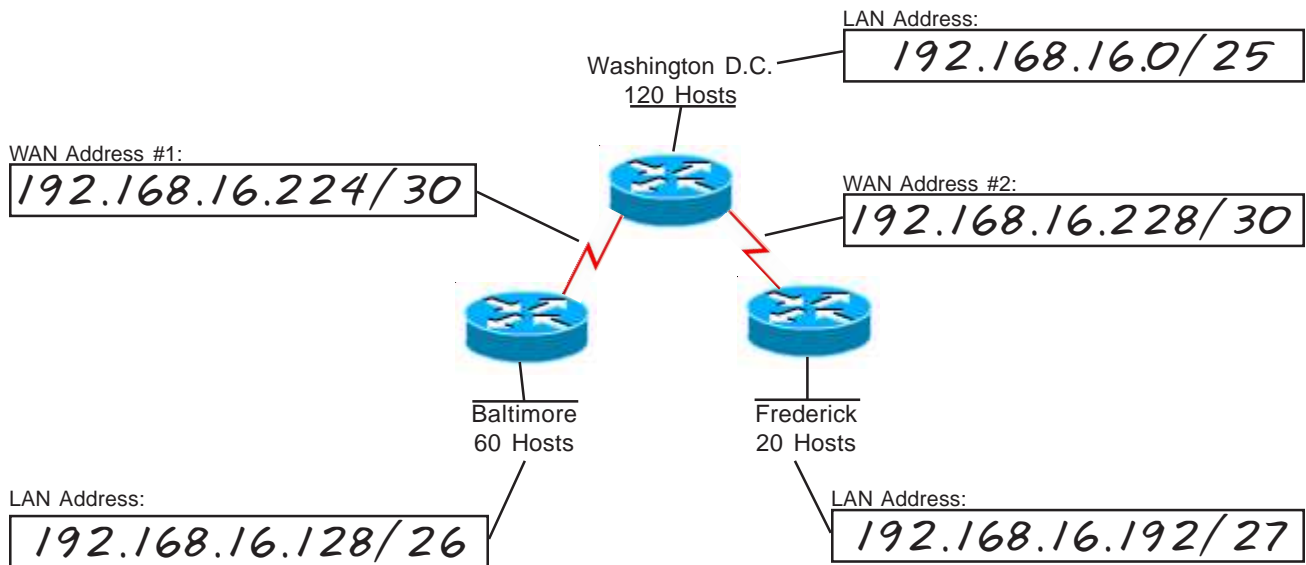
VLSM Addressing

Numeric Method

(Sample)

Problem 10

Using the network diagram and information given create an addressing scheme which utilizes variable-length subnet masks. Layout and show the subnet address and CIDR in the space below. This business will be using the class C address 192.168.16.0. Start with your largest groups first.



Show your work for Problem 10 in the space below.

	120 Hosts	60 Hosts	20 Hosts	2 Hosts						Number of Hosts
Number of Subnets	256	128	64	32	16	8	4	2	-	
	2	4	8	16	32	64	128	256		
	128	64	32	16	8	4	2	1	-	Binary values
	192	10	10	0	0	0	0	0	0	

<u>Hosts</u>	<u>Address Ranges</u>		<u>CIDR</u>
120	192.168.16.0	to 192.168.16.127	/25
60	192.168.16.128	to 192.168.16.191	/26
20	192.168.16.192	to 192.168.16.223	/27
2	192.168.16.224	to 192.168.16.227	/30
2	192.168.16.228	to 192.168.16.231	/30

VLSM Addressing

Numeric Method

Problem 11

Using the network diagram and information given create an addressing scheme which utilizes variable-length subnet masks. Layout and show the subnet address and CIDR in the space below. This business will be using the class C address 200.20.20.0. Start with your largest groups first.

LAN Address:

Marketing
Department
100 Hosts

Marketing
Department
50 Hosts

Department
25 Hosts



LAN Address:

LAN Address:

Show your work for Problem 11 in the space below.

	100 Hosts	50 Hosts	25 Hosts							Number of Hosts
Number of Subnets	2	4	8	16	32	64	128	256	-	
	128	64	32	16	8	4	2	1	-	Binary values
200.20.20.0 0 0 0 0 0 0 0										

Hosts
100

Address Ranges

CIDR

50

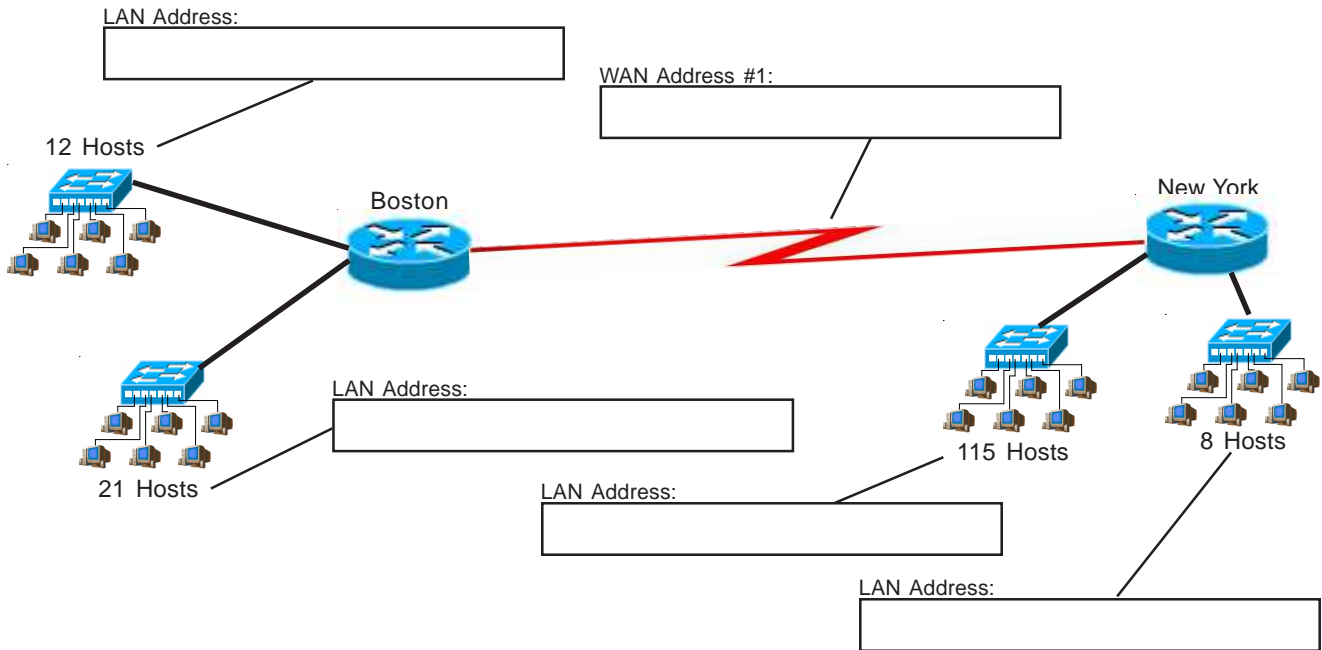
25

VLSM Addressing

Numeric Method

Problem 12

Using the network diagram and information given create an addressing scheme which utilizes variable-length subnet masks. Layout and show the subnet address and CIDR in the space below. This business will be using the class C address 199.55.70.0. Start with your largest groups first.



Show your work for Problem 12 in the space below.

	<i>Hosts</i>		<i>Hosts</i>		<i>Hosts</i>		<i>Hosts</i>		
<i>Number of Subnets</i>	256	128	64	32	16	8	4	2	- <i>Number of Hosts</i>
	2	4	8	16	32	64	128	256	
	128	64	32	16	8	4	2	1	- <i>Binary values</i>
199.55.70.0	0	0	0	0	0	0	0	0	

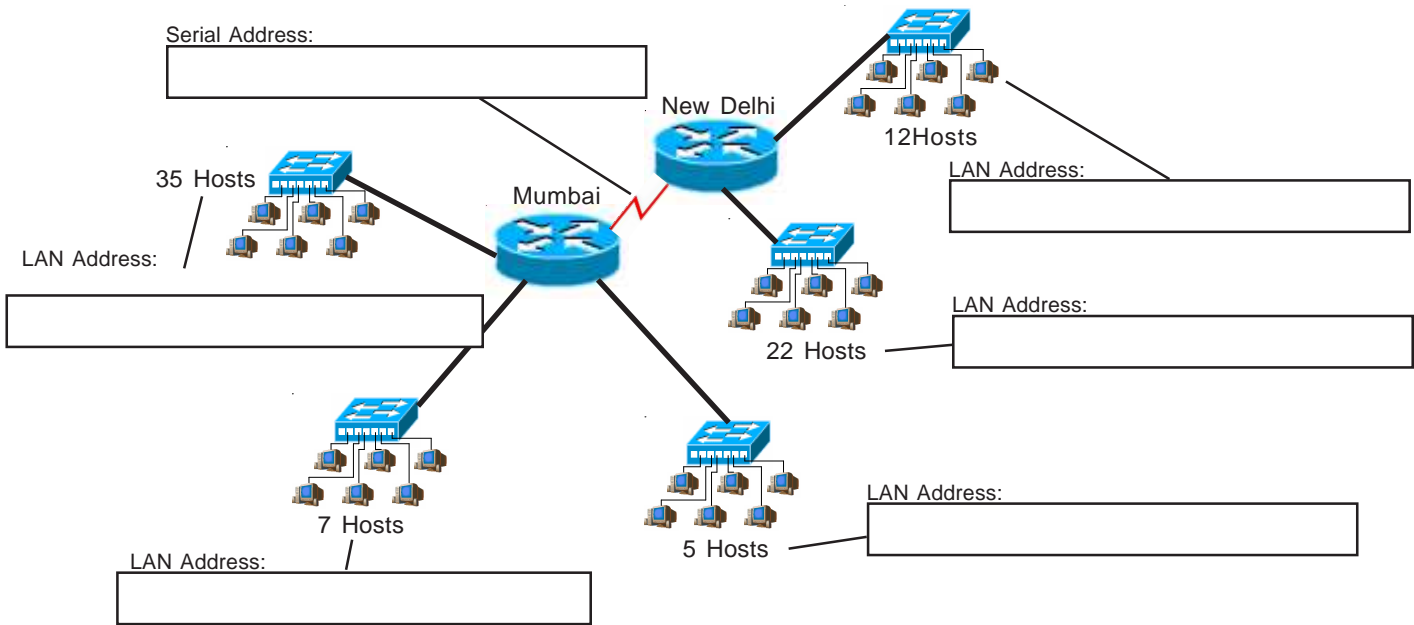
<u>Hosts</u>	<u>Address Ranges</u>	<u>CIDR</u>
115		
21		
12		
8		
2		

VLSM Addressing

Numeric Method

Problem 13

Using the network diagram and information given create an addressing scheme which utilizes variable-length subnet masks. Layout and show the subnet address and CIDR in the space below. This business will be using the class C address 200.150.70.0. Start with your largest groups first.



Show your work for Problem 13 in the space below.

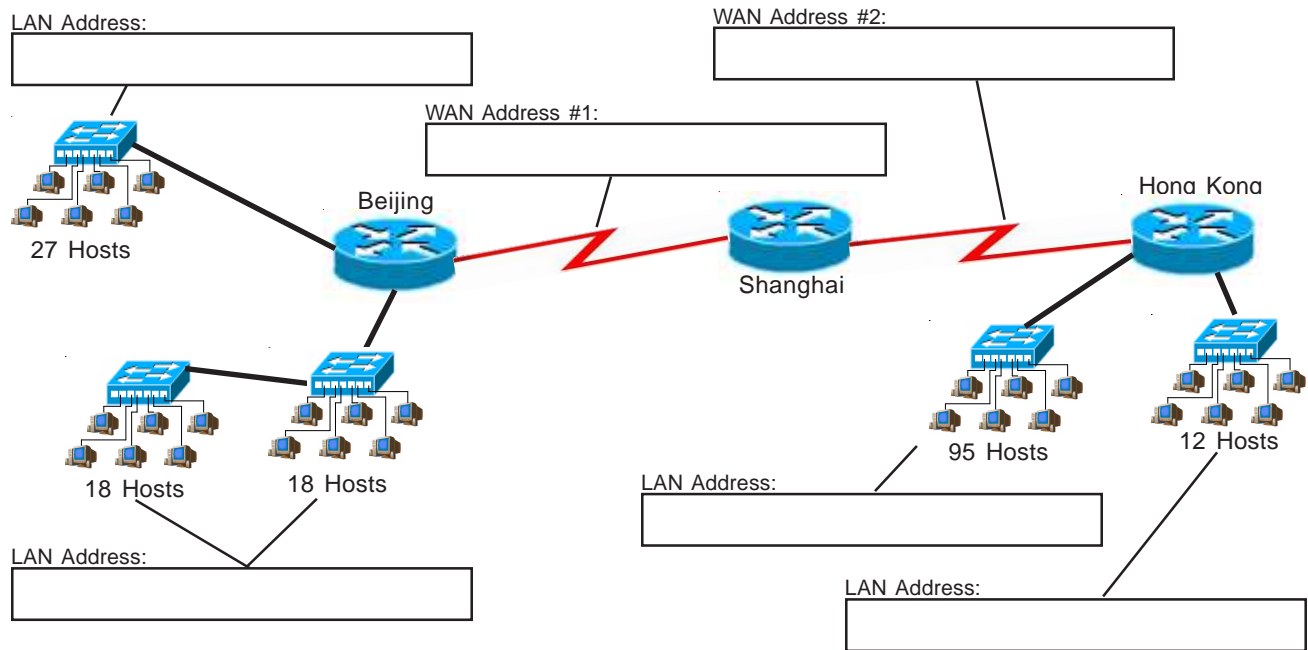
	256	128	64	32	16	8	4	2	-	Number of Hosts
Number of Subnets	-	2	4	8	16	32	64	128	256	
	128	64	32	16	8	4	2	1	-	Binary values
200.150.70.0	0	0	0	0	0	0	0	0	0	
<u>Hosts</u>	<u>Address Ranges</u>								<u>CIDR</u>	

VLSM Addressing

Numeric Method

Problem 14

Using the network diagram and information given create an addressing scheme which utilizes variable-length subnet masks. Layout and show the subnet address and CIDR in the space below. This business will be using the class C address 210.10.10.0. Start with your largest groups first.



Show your work for Problem 14 in the space below.

210.10.10.00000000

Hosts

Address Ranges

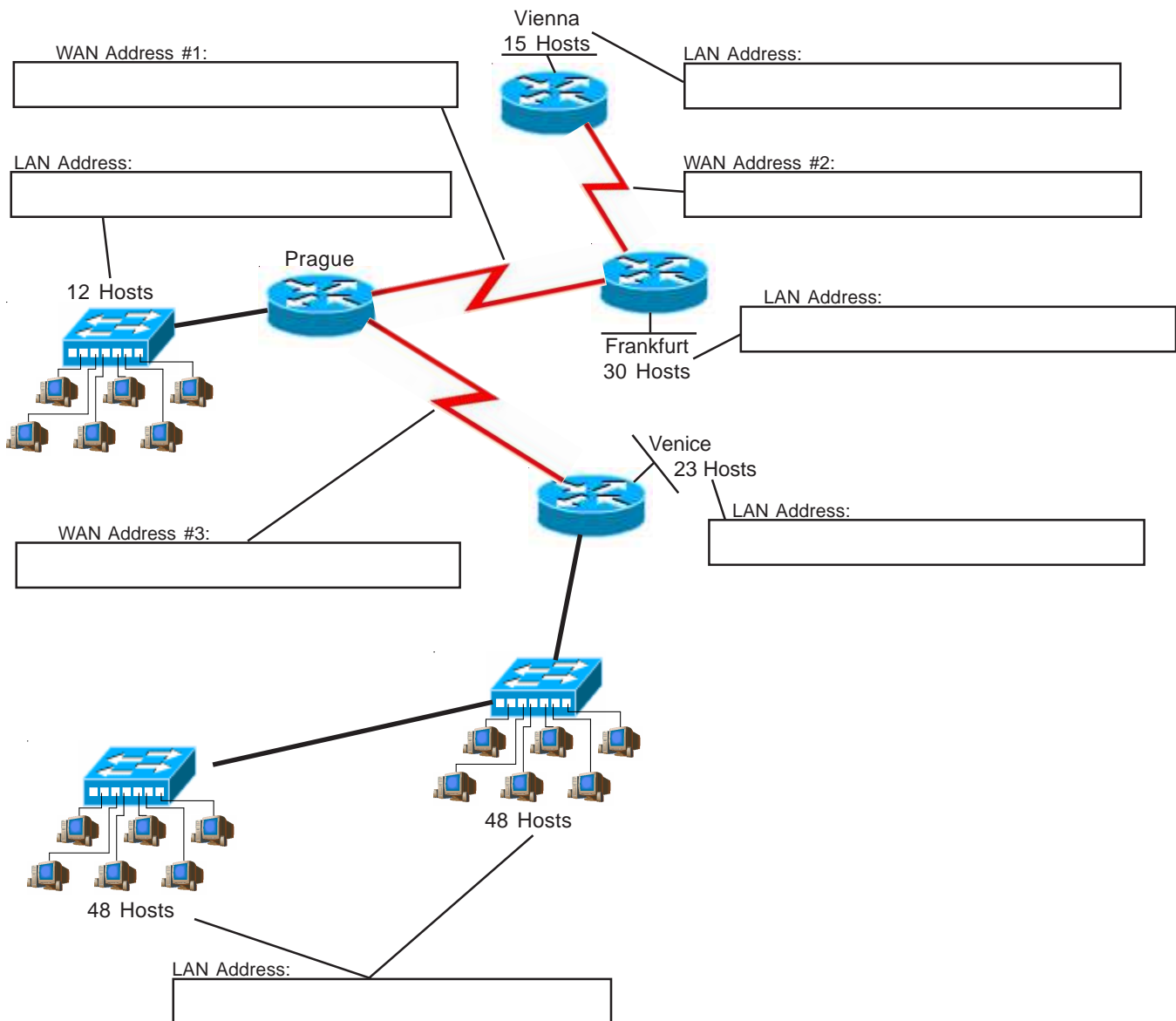
CIDR

VLSM Addressing

Numeric Method

Problem 15

Using the network diagram and information given create an addressing scheme which utilizes variable-length subnet masks. Layout and show the subnet address and CIDR in the space below. This business will be using the class C address 192.168.150.0. Start with your largest groups first.



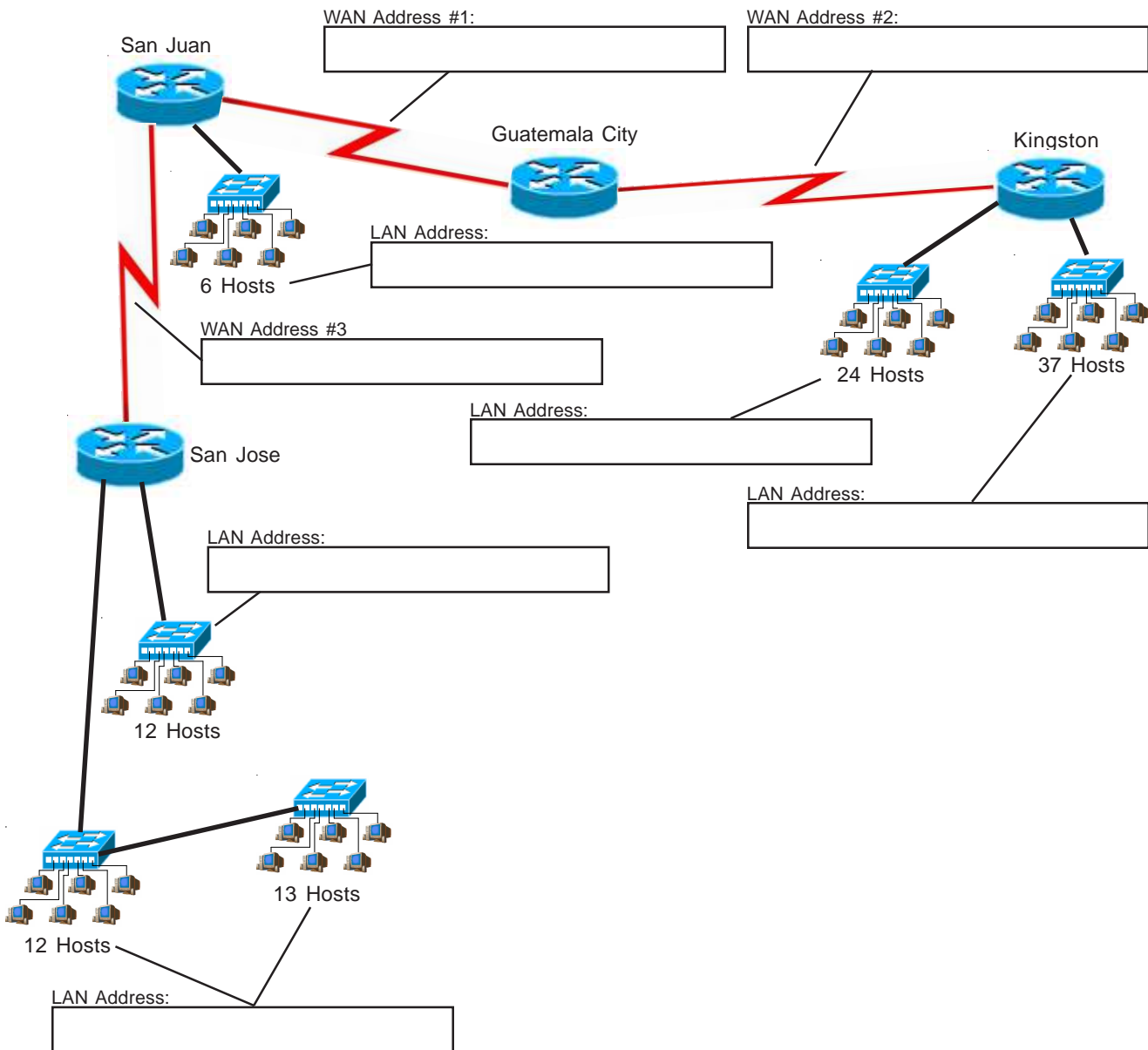
Show your work for Problem 15 in the space below.

VLSM Addressing

Numeric Method

Problem 16

Using the network diagram and information given create an addressing scheme which utilizes variable-length subnet masks. Layout and show the subnet address and CIDR in the space below. This business will be using the class C address 195.75.23.0. Start with your largest groups first.



Show your work for Problem 16 in the space below.

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.

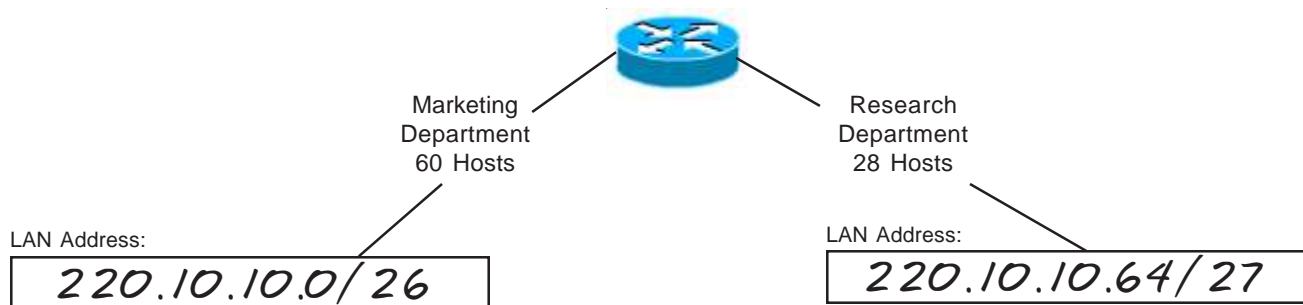
VLSM Addressing

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)

/24 255.255.255.0 256 Hosts	/25 255.255.255.128 128 Hosts	/26 255.255.255.192 64 Hosts	/27 255.255.255.224 32 Hosts	/28 255.255.255.240 16 Hosts	/29 255.255.255.248 8 Hosts	/30 255.255.255.252 4 Hosts
0 - 255	0-127	0-63	0-31	0-15	0-7	0-3
					8-15	4-7
						8-11
						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	
					40-43	
					44-47	
			48-63	48-55	48-51	
					52-55	
					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	
					88-91	
					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	16-167	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	192-195			
			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			

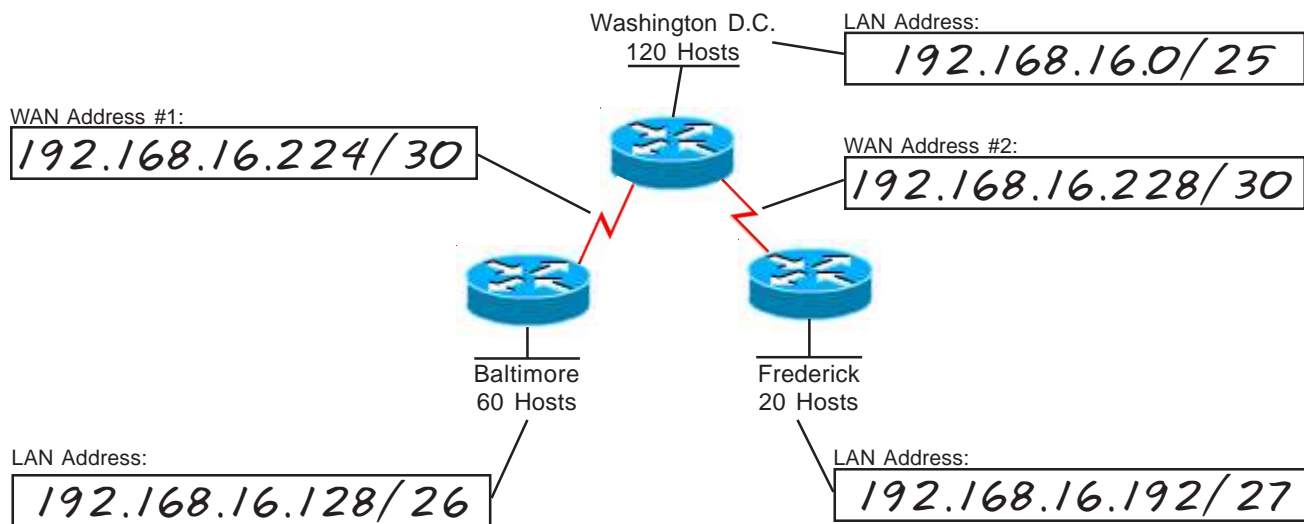
VLSM Addressing

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)

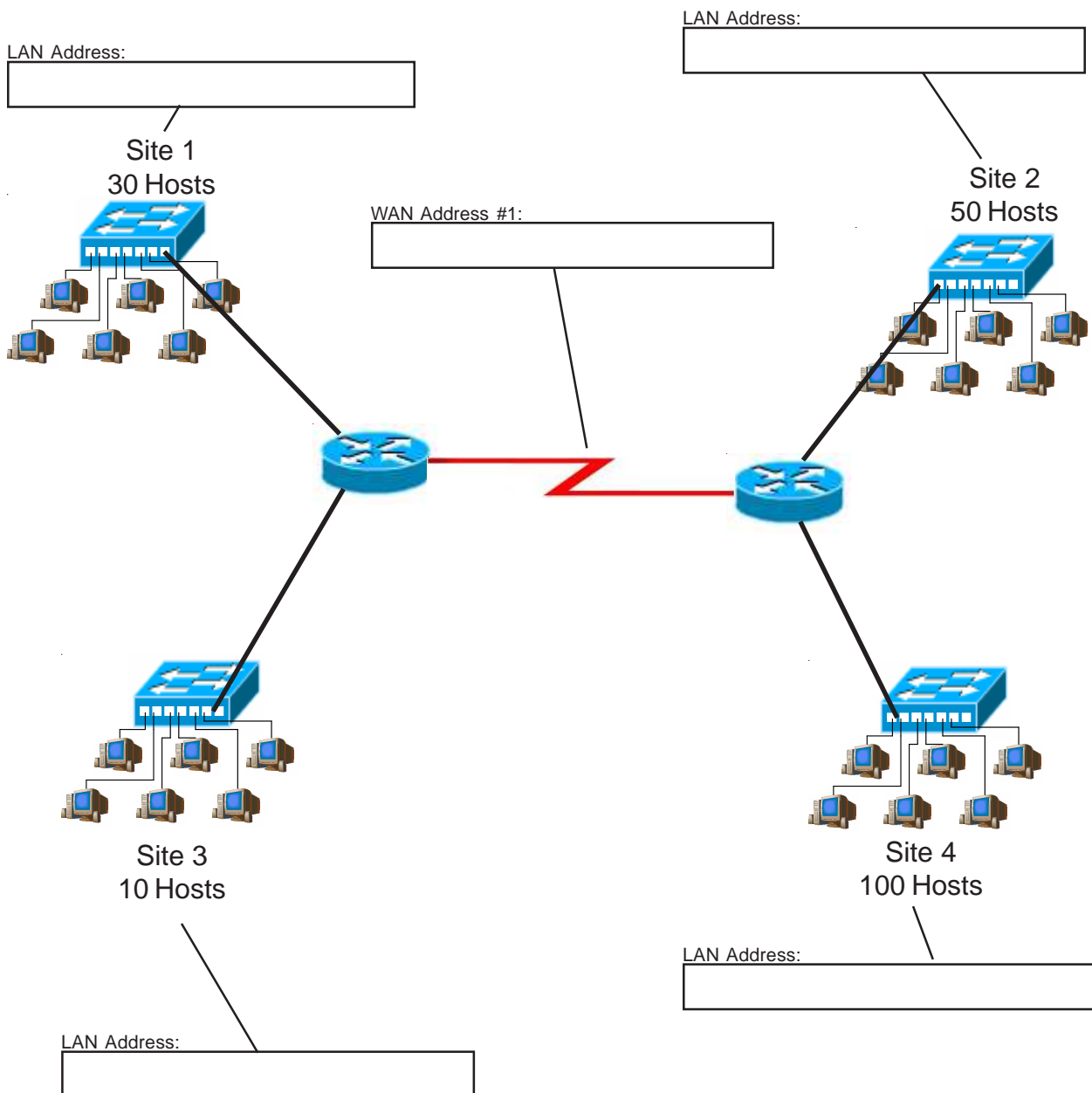
/24 255.255.255.0 256 Hosts	/25 255.255.255.128 128 Hosts	/26 255.255.255.192 64 Hosts	/27 255.255.255.224 32 Hosts	/28 255.255.255.240 16 Hosts	/29 255.255.255.248 8 Hosts	/30 255.255.255.252 4 Hosts
0 - 255	0-127	0-63	0-31	0-15	0-7	0-3
					8-15	4-7
				16-31	8-11	
					12-15	
			32-63	64-95	16-19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

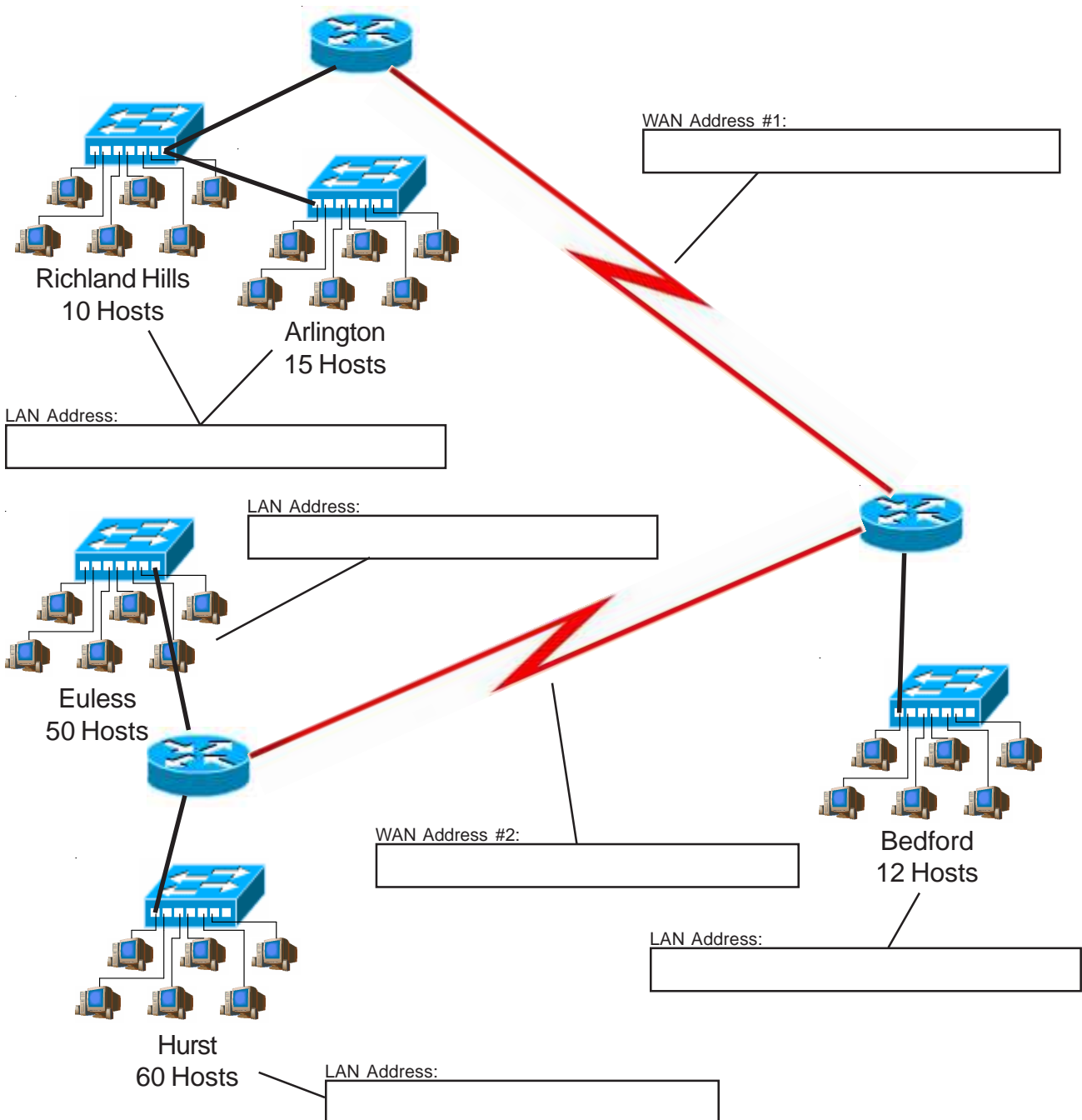
/24	/25	/26	/27	/28	/29	/30		
255.255.255.0 256 Hosts	255.255.255.128 128 Hosts	255.255.255.192 64 Hosts	255.255.255.224 32 Hosts	255.255.255.240 16 Hosts	255.255.255.248 8 Hosts	255.255.255.252 4 Hosts		
0 - 255	0-127	0-63	0-31	0-15	0-7	0-3		
					8-15	4-7	8-11	
				16-31	16-23	12-15	16-19	
					24-31	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	
					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		
				136-143	132-135	136-139		
				144-159	144-151	140-143	144-147	
					152-159	148-151	152-155	
			160-191	160-175	16-167	156-159	160-163	
					168-175	164-167	168-171	
				176-191	172-175	172-175	176-179	
					176-183	176-179	180-183	
		192-255	192-223	192-207	184-191	184-187	188-191	
					192-199	192-195	196-199	
				208-223	200-207	200-203	204-207	
					208-215	208-211	212-215	
			224-255	224-239	216-223	216-219	220-223	
					224-231	224-227	228-231	
				240-255	232-239	232-235	236-239	
					240-247	240-243	244-247	
			248-255	248-251	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)

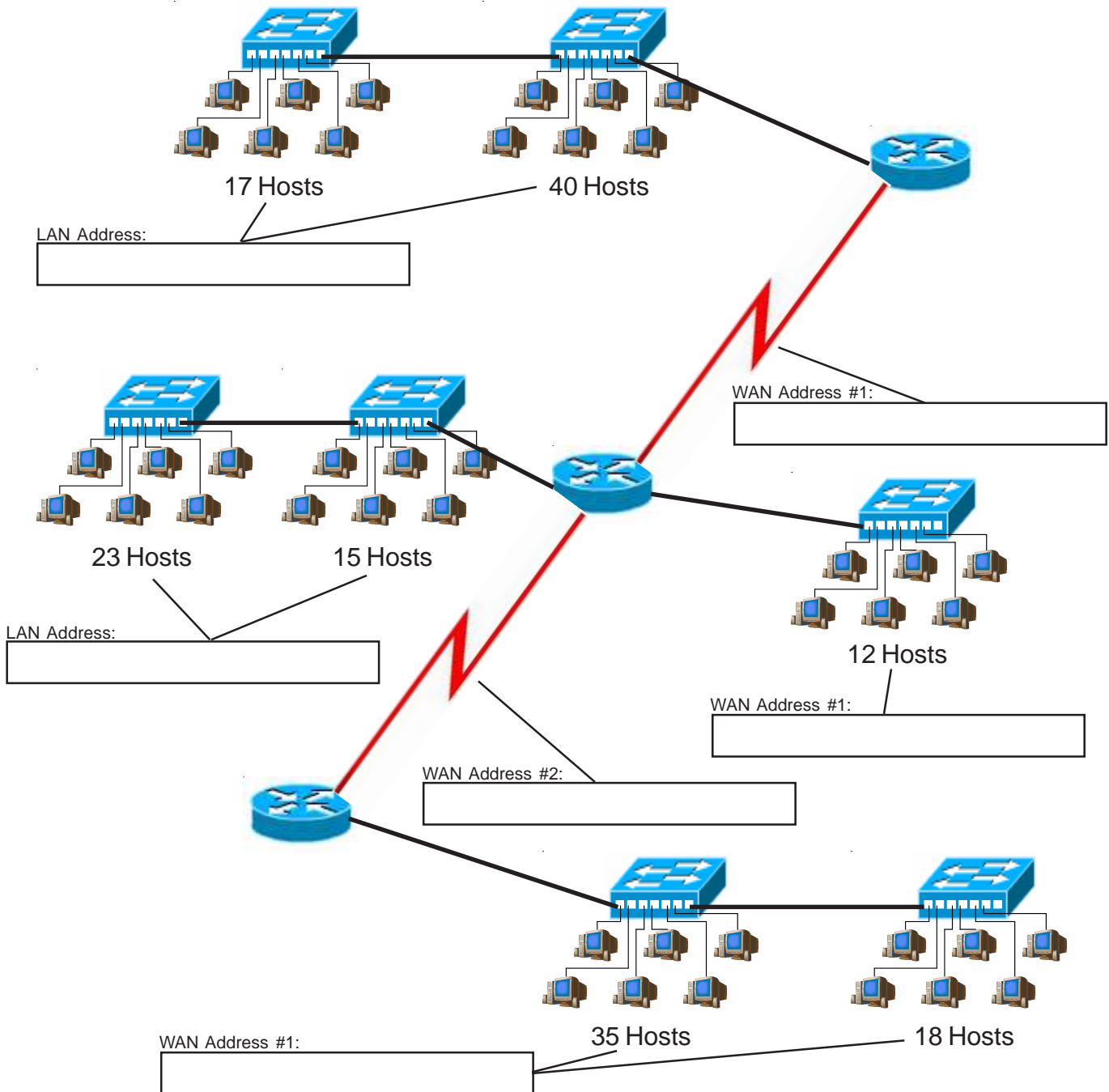
/24	/25	/26	/27	/28	/29	/30		
255.255.255.0 256 Hosts	255.255.255.128 128 Hosts	255.255.255.192 64 Hosts	255.255.255.224 32 Hosts	255.255.255.240 16 Hosts	255.255.255.248 8 Hosts	255.255.255.252 4 Hosts		
0 - 255	0-127	0-63	0-31	0-15	0-7	0-3		
					8-15	4-7	8-11	
				16-31	16-23	12-15	16-19	
					24-31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

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)

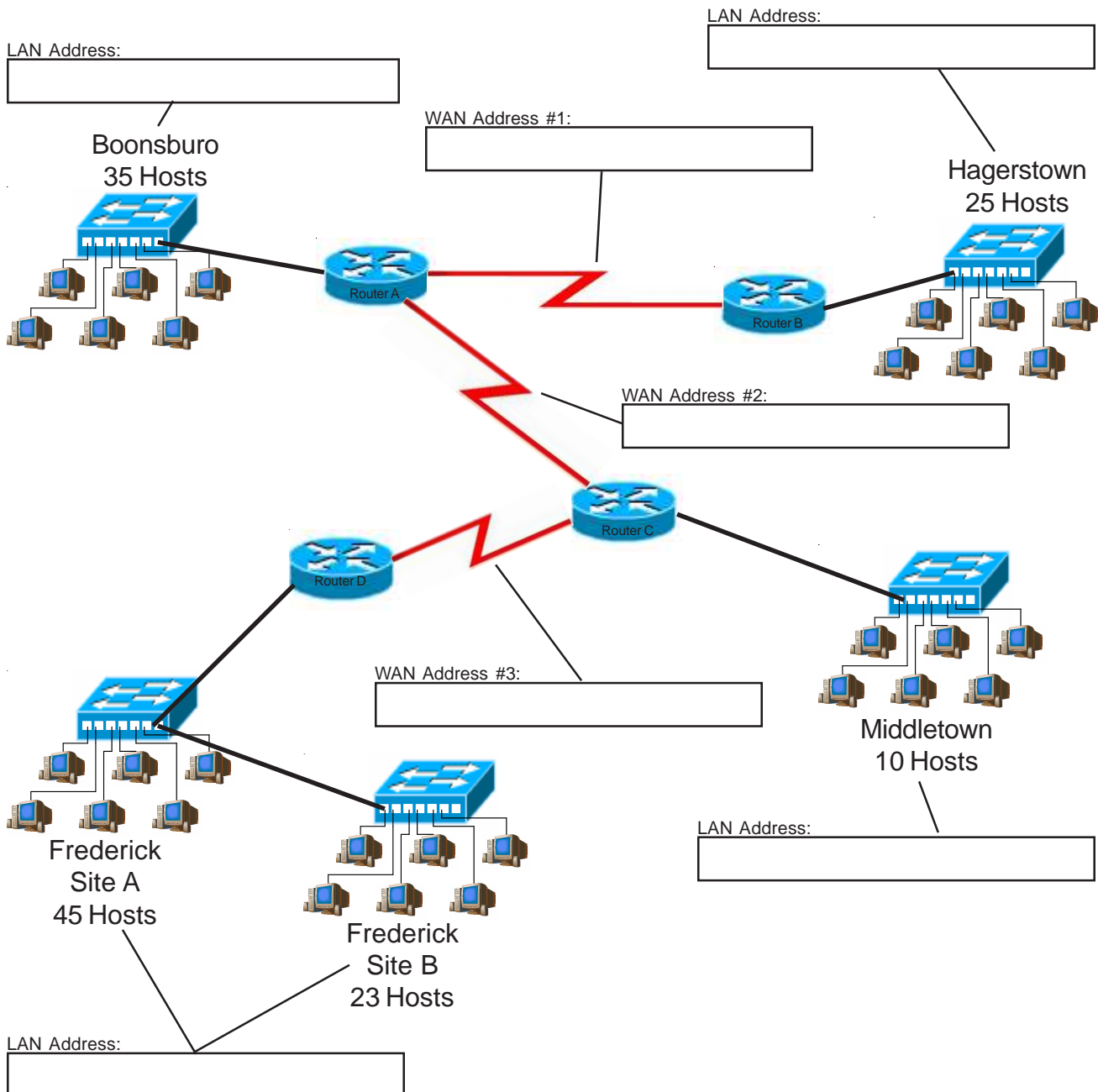
/24 255.255.255.0 256 Hosts	/25 255.255.255.128 128 Hosts	/26 255.255.255.192 64 Hosts	/27 255.255.255.224 32 Hosts	/28 255.255.255.240 16 Hosts	/29 255.255.255.248 8 Hosts	/30 255.255.255.252 4 Hosts
0 - 255	0-127	0-63	0-31	0-15	0-7	0-3
						4-7
					8-15	8-11
						12-15
			16-31	16-23	16-19	
					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	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	192-199	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)

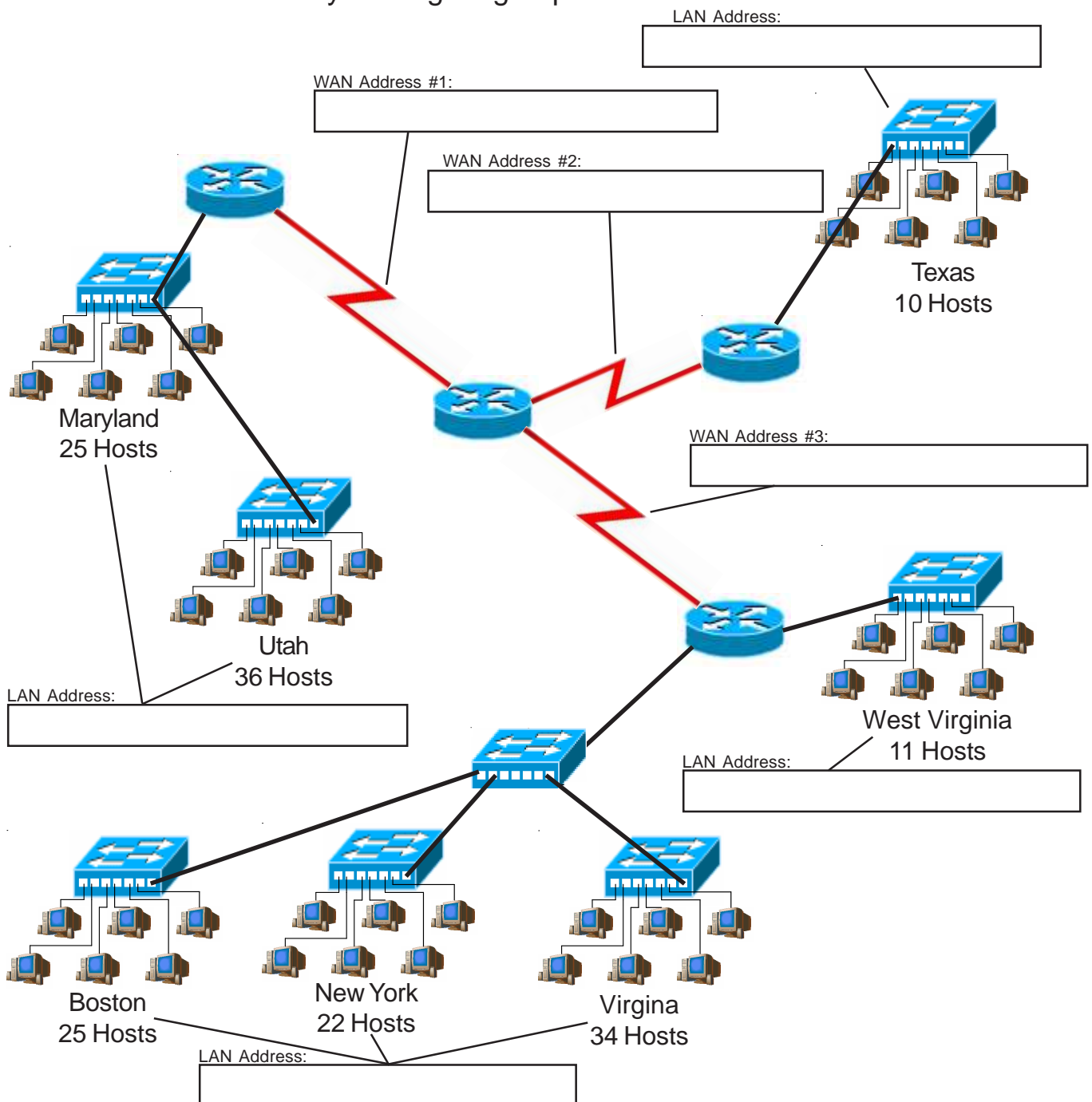
/24 255.255.255.0 256 Hosts	/25 255.255.255.128 128 Hosts	/26 255.255.255.192 64 Hosts	/27 255.255.255.224 32 Hosts	/28 255.255.255.240 16 Hosts	/29 255.255.255.248 8 Hosts	/30 255.255.255.252 4 Hosts		
0 - 255	0-127	0-63	0-31	0-15	0-7	0-3		
					8-15	4-7	8-11	
				16-31	16-23	12-15	16-19	
					24-31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

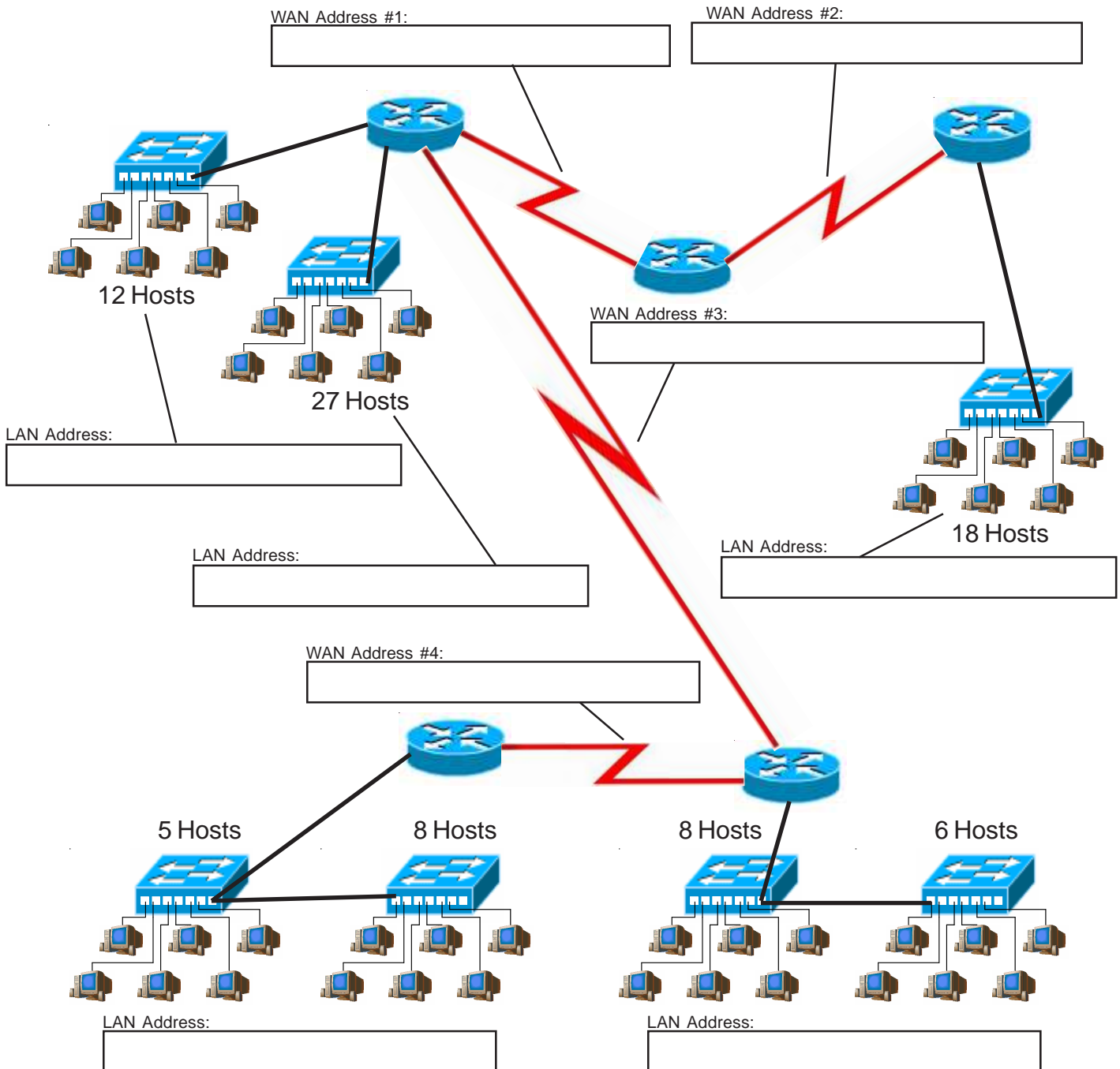
/24 255.255.255.0 256 Hosts	/25 255.255.255.128 128 Hosts	/26 255.255.255.192 64 Hosts	/27 255.255.255.224 32 Hosts	/28 255.255.255.240 16 Hosts	/29 255.255.255.248 8 Hosts	/30 255.255.255.252 4 Hosts
0 - 255	0-127	0-63	0-31	0-15	0-7	0-3
					8-15	4-7
				16-31	16-23	8-11
					24-31	12-15
			32-63	32-47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

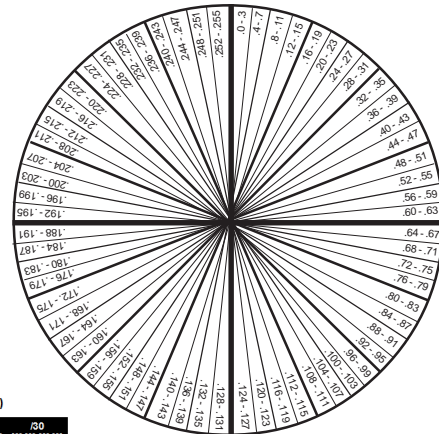
/24 255.255.255.0 256 Hosts	/25 255.255.255.128 128 Hosts	/26 255.255.255.192 64 Hosts			/29 255.255.255.248 8 Hosts	/30 255.255.255.252 4 Hosts
0 - 255	0-127	0-63	0-31	0-15	0-7	0-3
						4-7
					8-15	8-11
						12-15
			16-31	16-23	16-19	
					20-23	
				24-31	24-27	
					28-31	
		32-63	32-47	32-39	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.

(Reference pages are in the back of the workbook.)

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 Chart 24-30 Bits (4th octet)

/24 256 Hosts		/25 128 Hosts		/26 64 Hosts		/27 32 Hosts		/28 16 Hosts		/29 8 Hosts		/30 4 Hosts	
0 - 255													
0-7													
8-15													
16-23													
24-31													
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													

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 sub-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 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 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

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

10	11	12	13	14	15
205,000.0 117,280 hosts	206,000.0 63,680 hosts	207,000.0 31,840 hosts	208,000.0 15,920 hosts	209,000.0 7,960 hosts	210,000.0 3,980 hosts
0-255	0-63	0-31	0-7	8-15	16-31
			32-47	48-63	64-79
		32-63	32-47	48-63	64-79
			80-95	96-111	112-127
	64-127	64-95	64-79	80-95	96-111
			112-127	128-143	144-159
		96-127	96-111	112-127	128-143
			144-159	160-175	176-191
	128-255	128-191	128-143	144-159	160-175
			176-191	192-207	208-223
		192-255	192-207	208-223	224-239
			240-255	256-271	272-287

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

16	17	18	19	20	21	22	23	
215,000.0 65,536 hosts	216,000.0 32,768 hosts	217,000.0 16,384 hosts	218,000.0 8,192 hosts	219,000.0 4,096 hosts	220,000.0 2,048 hosts	221,000.0 1,024 hosts	222,000.0 512 hosts	
0-255	0-63	0-31	0-15	16-31	32-47	48-63	64-79	
			80-95	96-111	112-127	128-143		
		32-63	32-47	48-63	64-79	80-95	96-111	112-127
			128-143	144-159	160-175	176-191	192-207	208-223
	64-127	64-95	64-79	80-95	96-111	112-127	128-143	
			144-159	160-175	176-191	192-207	208-223	
		96-127	96-111	112-127	128-143	144-159	160-175	176-191
			192-207	208-223	224-239	240-255	256-271	272-287
	128-255	128-191	128-143	144-159	160-175	176-191	192-207	
			208-223	224-239	240-255	256-271	272-287	
		192-255	192-207	208-223	224-239	240-255	256-271	272-287
			288-303	304-319	320-335	336-351	352-367	368-383

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

24	25	26	27	28	29	30	
255,000.0 7,680 hosts	256,000.0 3,840 hosts	257,000.0 1,920 hosts	258,000.0 960 hosts	259,000.0 480 hosts	260,000.0 240 hosts	261,000.0 120 hosts	
0-255	0-63	0-31	0-15	16-31	32-47	48-63	
			64-79	80-95	96-111	112-127	
		32-63	32-47	48-63	64-79	80-95	96-111
			112-127	128-143	144-159	160-175	176-191
	64-127	64-95	64-79	80-95	96-111	112-127	
			128-143	144-159	160-175	176-191	
		96-127	96-111	112-127	128-143	144-159	160-175
			176-191	192-207	208-223	224-239	240-255
	128-255	128-191	128-143	144-159	160-175	176-191	
			192-207	208-223	224-239	240-255	
		192-255	192-207	208-223	224-239	240-255	256-271
			272-287	288-303	304-319	320-335	336-351

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	<i>15.0.0.0 to 15.127.255.255</i>	<i>/9</i>
Customer #2	2 million	<i>15.128.0.0 to 15.159.255.255</i>	<i>/11</i>
Customer #3	2,000,000	<i>15.160.0.0 to 15.191.255.255</i>	<i>/11</i>
Customer #4	1,000,000	<i>15.192.0.0 to 15.207.255.255</i>	<i>/12</i>
Customer #5	500,000	<i>15.208.0.0 to 15.215.255.255</i>	<i>/13</i>
Customer #6	450,000	<i>15.216.0.0 to 15.223.255.255</i>	<i>/13</i>
Customer #7	200,000	<i>15.224.0.0 to 15.227.255.255</i>	<i>/14</i>
Customer #8	130,000	<i>15.228.0.0 to 15.229.255.255</i>	<i>/15</i>
Customer #9	100,000	<i>15.230.0.0 to 15.231.255.255</i>	<i>/15</i>

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

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	<i>15.208.0.0 to 15.208.31.255</i>	<i>/19</i>
Client #2	5,000	<i>15.208.32.0 to 15.208.63.255</i>	<i>/19</i>
Client #3	4,500	<i>15.208.64.0 to 15.208.95.255</i>	<i>/19</i>
Client #4	2,000	<i>15.208.96.0 to 15.208.103.255</i>	<i>/21</i>
Client #5	1,450	<i>15.208.104.0 to 15.208.111.255</i>	<i>/21</i>
Client #6	1,150	<i>15.208.112.0 to 15.208.119.255</i>	<i>/21</i>
Client #7	900	<i>15.208.120.0 to 15.208.123.255</i>	<i>/22</i>
Client #8	750	<i>15.208.124.0 to 15.208.127.255</i>	<i>/22</i>
Client #9	450	<i>15.208.128.0 to 15.208.129.255</i>	<i>/23</i>

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

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)

/24 255.255.255.0 256 Hosts	/25 255.255.255.128 128 Hosts	/26 255.255.255.192 64 Hosts	/27 255.255.255.224 32 Hosts	/28 255.255.255.240 16 Hosts	/29 255.255.255.248 8 Hosts	/30 255.255.255.252 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	192-255	192-223		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 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			
			32-63	48-55	44-45	46-47			
				48-51	48-49	50-51			
				52-55	52-53	54-55			
				56-59	56-57	58-59			
				60-63	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	
					96-111	88-95	88-89	90-91	
		92-95				92-93	94-95		
		96-99				96-97	98-99		
		100-103		100-101		102-103			
		104-107		104-105		106-107			
		96-127		108-111	108-109	110-111			
				112-115	112-113	114-115			
				116-119	116-117	118-119			
				120-123	120-121	122-123			
				124-127	124-125	126-127			
		128-255		128-191	128-159	128-143	128-135	128-131	128-129
							132-135	130-131	132-133
							136-139	134-135	136-137
							140-143	136-137	138-139
							144-147	140-141	142-143
						144-159	144-151	144-145	146-147
							148-151	148-149	150-151
							152-155	152-153	154-155
			156-159				156-157	158-159	
			160-163				160-161	162-163	
			160-191		160-175	160-167	160-167	164-167	
						164-167	166-167	168-169	
						168-171	170-171	172-173	
						172-175	172-173	174-175	
						176-179	176-177	178-179	
			176-191		176-183	180-183	180-181	182-183	
	184-187					182-183	184-185		
	188-191					186-187	188-189		
	192-195					190-191	192-193		
	196-199					194-195	196-197		
	192-223		192-207		196-199	196-199	198-199		
					200-203	200-201	202-203		
					204-207	202-203	204-205		
					208-211	206-207	208-209		
					212-215	210-211	212-213		
	192-255		208-223	216-219	212-215	214-215			
				220-223	216-217	218-219			
				224-227	220-221	222-223			
				228-231	224-225	226-227			
				232-235	228-229	230-231			
	224-255		224-239	236-239	232-233	234-235			
				240-243	236-237	238-239			
				244-247	240-241	242-243			
				248-251	244-245	246-247			
				252-255	248-249	250-251			
	240-255		240-247	244-247	244-247	248-249			
				248-251	250-251	252-253			
				252-255	252-253	254-255			
				256-259	256-257	258-259			
				260-263	260-261	262-263			
	240-255		248-255	252-255	252-255	256-257			
				256-259	256-257	258-259			
				260-263	260-261	262-263			
				264-267	264-265	266-267			
				270-273	270-271	272-273			

VLSM

with

Class A and B Addresses

Problem 36

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

VLSM

with

Class A and B Addresses

Problem 36

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)

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

VLSM

with

Class A and B Addresses

Problem 37

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		

Numeric Method

Show your work for Problem 36 in the space below.

	65,536	32,768	16,384	8,192	4,096	2,048	1,024	512	256	128	64	32	16	8	4	2
Number of Hosts	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Number of Subnets	2	4	8	16	32	64	128	256	512	1024	2048	4096	8192	16384	32768	65536
Binary values	128	64	32	16	8	4	2	1	128	64	32	16	8	4	2	1

Hosts

Address Ranges

CIDR

VLSM

with

Class A and B Addresses

Problem 37

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.

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 address ranges.

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		

Numeric Method

Show your work for Problem 36 in the space below.

	256	128	64	32	16	8	4	2	-	Number of Hosts
Number of Subnets	-	2	4	8	16	32	64	128	256	
	128	64	32	16	8	4	2	1	-	Binary values
172.32.42	.0	0	0	0	0	0	0	0	0	

Hosts

Address Ranges

CIDR

	256	128	64	32	16	8	4	2	-	Number of Hosts
Number of Subnets	-	2	4	8	16	32	64	128	256	
	128	64	32	16	8	4	2	1	-	Binary values
172.32.43	.0	0	0	0	0	0	0	0	0	

Hosts

Address Ranges

CIDR

VLSM

with

Class A and B Addresses

Problem 37

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.

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		

Numeric Method

Show your work for Problem 36 in the space below.

Reminder - Keep within the South High School address range.

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

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)

/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
				16-31	8-15	4-7	2-3
					16-23	8-11	4-5
					24-31	12-15	6-7
						16-19	8-9
						20-23	10-11
			32-63	32-47	32-39	12-13	
					40-47	14-15	
					48-55	16-17	
				48-63	56-63	18-19	
						20-21	
						22-23	
		64-127	64-95	64-79	64-71	24-25	
					72-79	26-27	
					80-87	28-29	
				80-95	88-95	30-31	
						32-33	
						34-35	
			96-127	96-111	96-103	36-37	
					104-111	38-39	
					112-119	40-41	
				112-127	120-127	42-43	
						44-45	
						46-47	
	128-255	128-191	128-159	128-143	48-49		
				136-143	50-51		
				144-151	52-53		
				152-159	54-55		
				160-167	56-57		
				168-175	58-59		
			160-191	160-175	176-175	60-61	
					176-183	62-63	
					184-191	64-65	
				176-191	192-199	66-67	
						68-69	
						70-71	
			72-73				
			74-75				
			76-77				
		192-255	192-223	192-207	192-199	78-79	
					200-207	80-81	
					208-215	82-83	
				208-223	216-215	84-85	
					216-223	86-87	
					224-223	88-89	
			224-255	224-239	224-231	90-91	
					232-239	92-93	
					240-247	94-95	
	240-255			240-247	96-99		
				248-251	98-99		
				248-255	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					

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

Reference Charts and Support Materials

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

10	11	12	13	14	15	
208,000.0 127,000 hosts	208,000.0 63,500 hosts	208,000.0 31,750 hosts	208,000.0 15,875 hosts	208,000.0 7,937.5 hosts	208,000.0 3,968.75 hosts	
0-255	0-63	0-15	0-7	8-15	16-31	
			16-31	32-47	48-63	
			64-79	80-95	96-111	
		64-127	64-79	80-95	96-111	112-127
				128-143	144-159	160-175
				176-191	192-207	208-223
	128-255	128-191	192-207	208-223	224-239	
			240-255			
		192-255	192-207	208-223	224-239	240-255

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

16	17	18	19	20	21	22	23
208,000.0 63,500 hosts	208,000.0 31,750 hosts	208,000.0 15,875 hosts	208,000.0 7,937.5 hosts	208,000.0 3,968.75 hosts	208,000.0 1,984.375 hosts	208,000.0 992.1875 hosts	208,000.0 496.09375 hosts
0-255	0-63	0-15	0-7	8-15	16-31	32-47	48-63
			64-79	80-95	96-111	112-127	
			128-143	144-159	160-175	176-191	
		64-127	64-79	80-95	96-111	112-127	
				128-143	144-159	160-175	
				176-191	192-207	208-223	
	128-255	128-191	192-207	208-223	224-239	240-255	
		192-255	192-207	208-223	224-239	240-255	

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

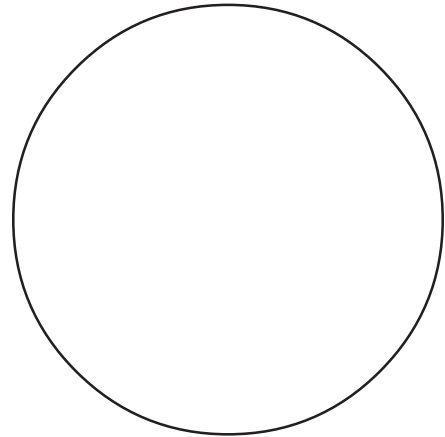
24	25	26	27	28	29	30
208,000.0 63,500 hosts	208,000.0 31,750 hosts	208,000.0 15,875 hosts	208,000.0 7,937.5 hosts	208,000.0 3,968.75 hosts	208,000.0 1,984.375 hosts	208,000.0 992.1875 hosts
0-255	0-63	0-15	0-7	8-15	16-31	32-47
			48-63	64-79	80-95	96-111
			112-127	128-143	144-159	160-175
		64-127	64-79	80-95	96-111	112-127
				128-143	144-159	160-175
				176-191	192-207	208-223
	128-255	128-191	192-207	208-223	224-239	240-255
		192-255	192-207	208-223	224-239	240-255

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.

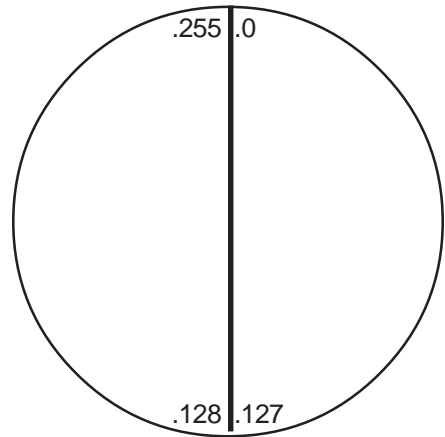
Start with a circle. The whole circle is a single subnet comprised of 256 addresses.

/24
255.255.255.0
256 Hosts
1 Subnet



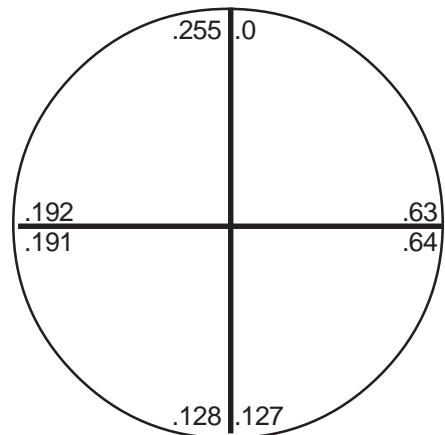
Split the circle in half and you get two subnets with 128 addresses.

/25
255.255.255.128
128 Hosts
2 Subnets



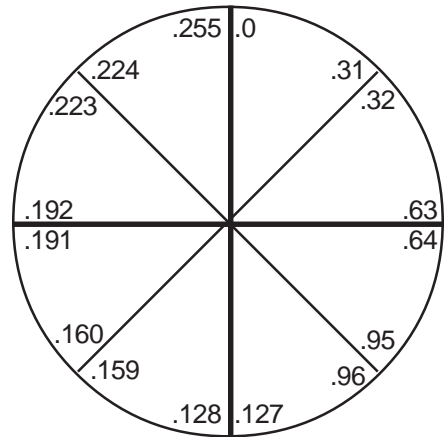
Divide the circle into quarters and you get four subnets with 64 addresses.

/26
255.255.255.192
64 Hosts
4 Subnets



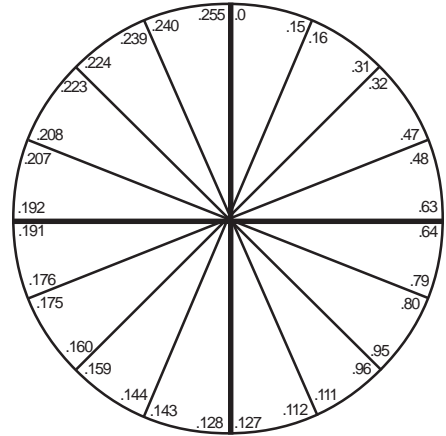
Split each quarter and you get eight subnets with 32 addresses.

/27
255.255.255.224
32 Hosts
8 Subnets



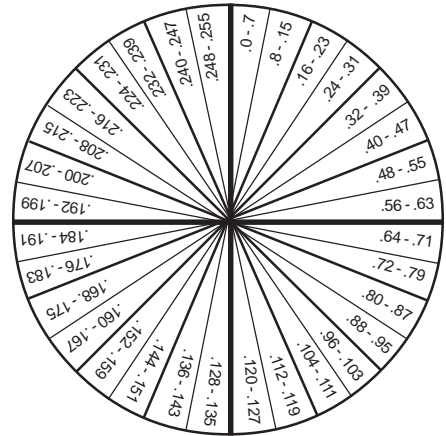
Split the boxes in half again and you get sixteen subnets with sixteen addresses.

/28
255.255.255.240
16 Hosts
16 Subnets



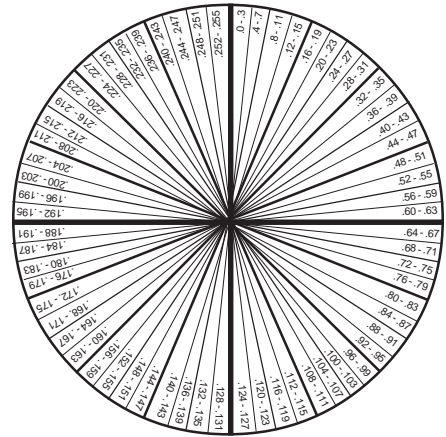
The next split gives you thirty two subnets with eight addresses.

/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

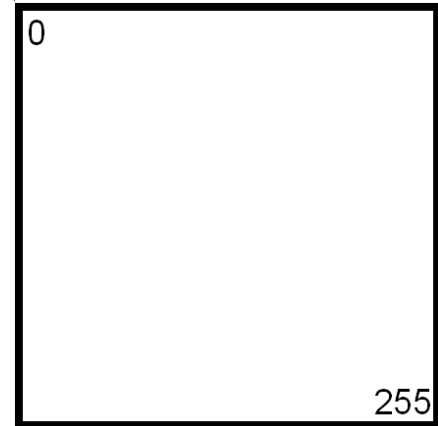


Visualizing Subnets Using The Box Method

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.

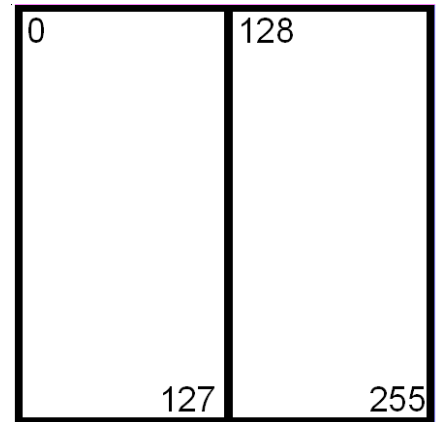
Start with a square. The whole square is a single subnet comprised of 256 addresses.

/24
255.255.255.0
256 Hosts
1 Subnet



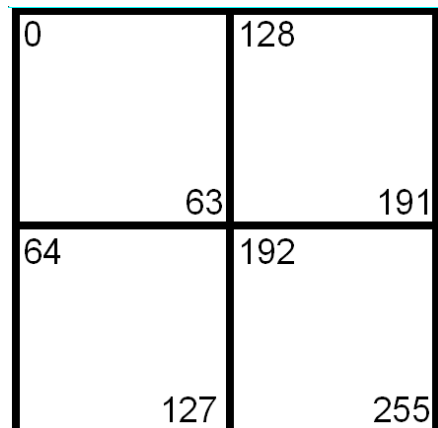
Split the box in half and you get two subnets with 128 addresses.

/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

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	6-7	
						12-15	6-7	8-9	
						16-19	10-11	8-9	10-11
							12-13	10-11	12-13
					20-23	14-15	12-13	14-15	
						24-27	16-17	16-17	18-19
			18-19				20-21	22-23	
			24-31			20-21	22-23	24-25	
				22-23	24-25	26-27			
				26-27	26-27	28-29	30-31		
					28-29	30-31	32-33		
			32-63	32-39	32-35	32-33	34-35	36-37	
						34-35	36-37	38-39	
					36-39	36-37	38-39	40-41	
		38-39				40-41	42-43		
		40-47		40-41	42-43	44-45			
				42-43	44-45	46-47			
				44-47	44-45	46-47	48-49		
					46-47	48-49	50-51		
		48-63	48-55	48-51	52-55	54-55			
				52-55	54-55	56-57			
			56-63	56-59	58-59	60-61			
				60-63	62-63	64-65			
		64-127	64-79	64-71	64-67	66-67	68-69		
					68-71	66-67	68-69		
				72-79	72-75	74-75	76-77		
	76-79				74-75	76-77			
	80-95		80-87	80-81	82-83	84-85			
				84-87	82-83	84-85			
			88-95	88-91	86-87	88-89			
				92-95	86-87	88-89			
	96-127	96-111	96-103	96-99	98-99	100-101			
				100-103	98-99	100-101			
			104-111	104-107	102-103	104-105			
				108-111	102-103	104-105			
		112-127	112-119	112-115	114-115	116-117			
				116-119	114-115	116-117			
			120-123	120-121	118-119	120-121			
				122-123	118-119	120-121			
	124-127	124-125	122-123	124-125					
		126-127	122-123	124-125					
		128-129	126-127	128-129	130-131				
			128-129	130-131	132-133				
	128-255	128-191	128-159	128-143	128-131	132-133	134-135		
					132-135	134-135	136-137		
				136-143	136-137	138-139	140-141		
					140-143	138-139	140-141		
			144-159	144-151	144-147	146-147	148-149		
					148-151	146-147	148-149		
				152-159	152-155	150-151	152-153		
156-159					150-151	152-153			
160-191		160-175	160-167	160-163	164-165	166-167			
				164-167	164-165	166-167			
			168-175	168-171	166-167	168-169			
				172-175	166-167	168-169			
		176-191	176-183	176-179	178-179	180-181			
				180-183	178-179	180-181			
			184-191	184-187	182-183	184-185			
				188-191	182-183	184-185			
192-255	192-223	192-199	192-199	192-195	196-197	198-199			
				196-199	196-197	198-199			
			200-207	200-203	198-199	200-201			
				204-207	198-199	200-201			
		208-223	208-215	208-211	212-213	214-215			
				212-215	212-213	214-215			
			216-223	216-217	214-215	216-217			
				218-219	214-215	216-217			
	224-255	224-231	224-227	224-227	226-227	228-229			
				228-231	226-227	228-229			
			232-239	232-235	230-231	232-233			
				236-239	230-231	232-233			
		240-255	240-247	240-243	242-243	244-245			
				244-247	242-243	244-245			
			248-255	248-251	246-247	248-249			
				252-255	246-247	248-249			

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		
			30-31	18-19		16-17			
			32-33	20-21		18-19			
			64-127	32-63	32-47	32-39	32-35	32-35	20-21
							40-47	36-39	22-23
		48-63				40-43	24-25		
		56-63			44-47	26-27			
		64-71			48-51	28-29			
		64-79			52-55	30-31			
		64-95		80-95	80-87	80-83	54-55	32-33	
						88-95	56-57	34-35	
					96-103	58-59	36-37		
				96-127	96-111	96-103	100-103	60-61	38-39
							104-111	62-63	40-41
						112-119	64-67	42-43	
		112-127	112-119		112-115	66-67	44-45		
					120-123	68-69	46-47		
	120-127		70-71		48-49				
	128-255	128-191	128-159	128-143	128-135	68-69	50-51		
					136-143	70-71	52-53		
					140-143	72-73	54-55		
				144-159	144-147	74-75	56-57		
					148-151	76-77	58-59		
					152-155	78-79	60-61		
			160-191	160-175	160-167	160-163	80-81	62-63	
						164-167	82-83	64-65	
					168-175	84-85	66-67		
				176-191	176-183	176-179	86-87	68-69	
						180-183	88-89	70-71	
					184-191	90-91	72-73		
		192-255	192-223	192-207	192-199	192-195	92-93	74-75	
						196-199	94-95	76-77	
					200-207	96-97	78-79		
				208-223	200-207	200-203	98-99	80-81	
						204-207	100-101	82-83	
					208-215	102-103	84-85		
			224-255	208-223	208-215	208-211	104-105	86-87	
						212-215	106-107	88-89	
					216-223	108-111	90-91		
				224-239	216-223	216-219	110-111	92-93	
						220-223	112-113	94-95	
					224-231	114-115	96-97		
	240-255	224-239	224-231	224-227	116-117	98-99			
				228-231	118-119	100-101			
			232-239	120-121	102-103				
240-247		232-239	232-235	122-123	104-105				
			236-239	124-125	106-107				
		240-247	238-239	126-127					
248-255	240-247	240-243	240-243	128-129					
		244-247	242-243	130-131					
252-255	248-251	248-251	244-247	132-133					
		252-255	246-247	134-135					

Class C Addresses

VLSM Chart 24-30 Bits (4th octet)

/24 255.255.255.0 256 Hosts	/25 255.255.255.128 128 Hosts	/26 255.255.255.192 64 Hosts	/27 255.255.255.224 32 Hosts	/28 255.255.255.240 16 Hosts	/29 255.255.255.248 8 Hosts	/30 255.255.255.252 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		160-163			
			164-167			
			168-171			
			172-175			
	192-255	176-191		176-179		
				180-183		
				184-187		
				188-191		
192-207			192-195			
			196-199			
			200-203			
			204-207			
192-223	208-223		208-211			
			212-215			
	224-239		216-219			
			220-223			
224-255	224-239		224-227			
			228-231			
	240-255		232-235			
			236-239			
	240-243					
	244-247					
	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