

10.250.1.0
192.168.10.96
192.168.10.126
172.31.15.0

VLSM

Variable-Length Subnet Mask

Workbook

Version 2.0

Instructor's Edition

10.250.1.0

IP Address Classes

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

Private Address Space

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

Default Subnet Masks

Class A	255.0.0.0
Class B	255.255.0.0
Class C	255.255.255.0

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

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Special Thanks to Melvin Baker and Jim Dorsch
for taking the time to check this workbook for errors,
and to everyone who has sent in suggestions to improve the series.

Workbooks included in the series:

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

Instructors (and anyone else for that matter) please do not post the Instructors version on public websites. When you do this you are giving everyone else worldwide the answers. Yes, students look for answers this way. It also discourages others; myself included, from posting high quality materials.

Inside Cover

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

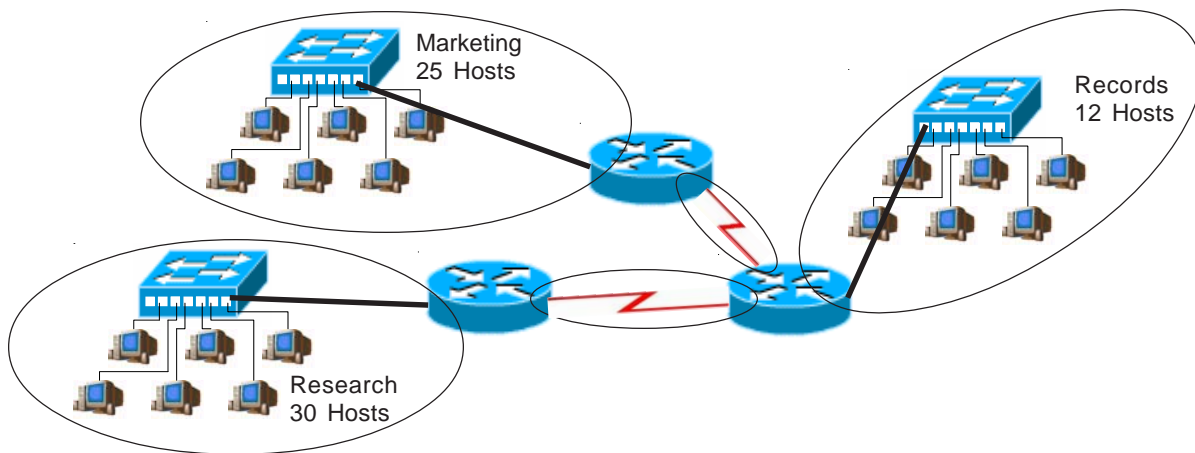
This workbook explores three different methods to figure out sub-subnets: the box method, the circle method, and a VLSM chart.

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

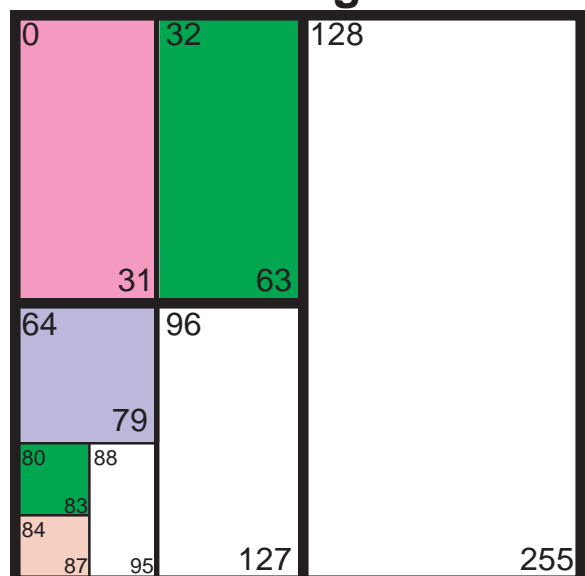


By adjusting the subnet masks you can cut your address usage by almost half in this example. This type of subnetting requires a network protocol which will support it such as: RIP version 2, EIGRP, OSPF, or BGP.

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

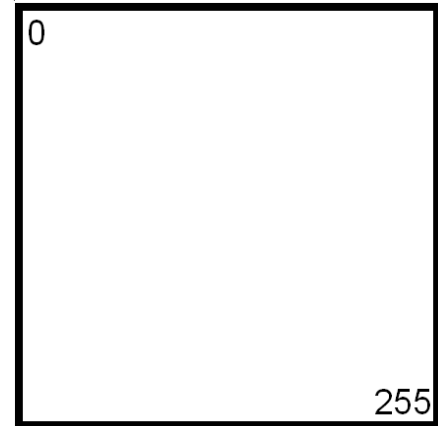


Visualizing Subnets Using The Box Method

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.

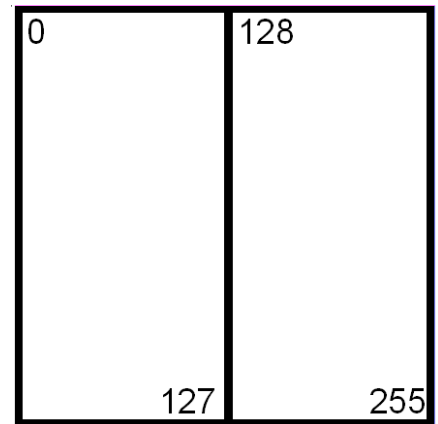
Start with a square. The whole square is a single subnet comprised of 256 addresses.

/24
255.255.255.0
256 Hosts
1 Subnet



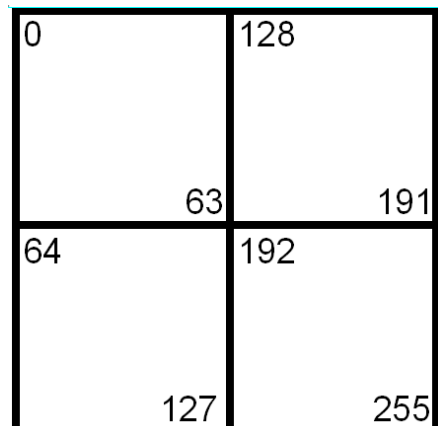
Split the box in half and you get two subnets with 128 addresses.

/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
64	96	192	224
	95	127	223
		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
16	48	144	176
	31	63	159
64	96	192	224
	79	111	207
80	112	208	240
	95	127	223
		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
16	24	48	56	144	152	176	184
	23	31	55	63	151	159	183
64	72	96	104	192	200	224	232
	71	79	103	111	199	207	321
80	88	112	120	208	216	240	248
	87	95	119	127	215	223	247
				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
4	12	36	44	132	140	164	172
	7	15	39	47	135	143	167
16	24	48	56	144	152	176	184
	19	27	51	59	147	155	179
20	28	52	60	148	156	180	188
	23	31	55	63	151	159	183
64	72	96	104	192	200	224	232
	67	75	99	107	195	203	227
68	76	100	108	196	204	228	236
	71	79	103	111	199	207	231
80	88	112	120	208	216	240	248
	83	91	115	123	211	219	243
84	92	116	124	212	220	244	252
	87	95	119	127	215	223	247
				215	223	247	255

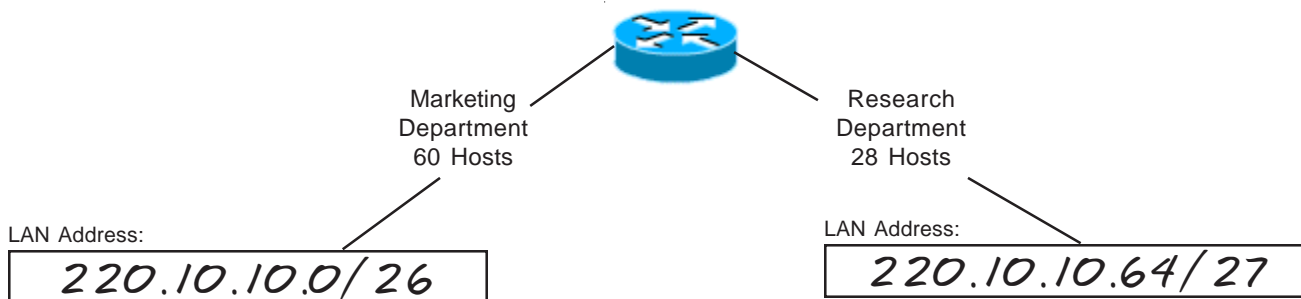
VLSM Addressing

Box Method

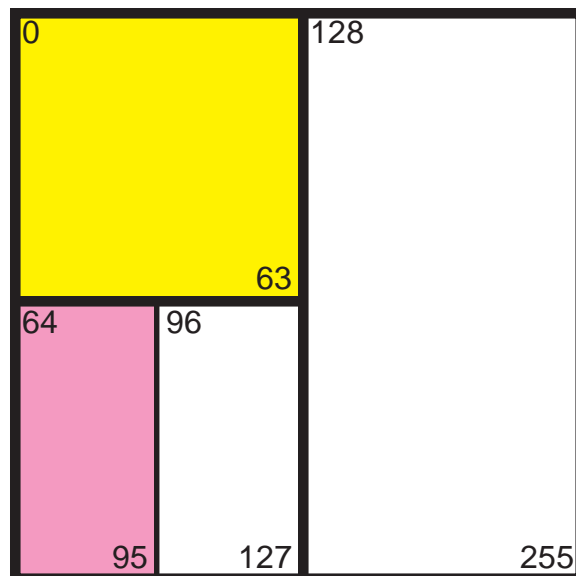
(Sample)

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.



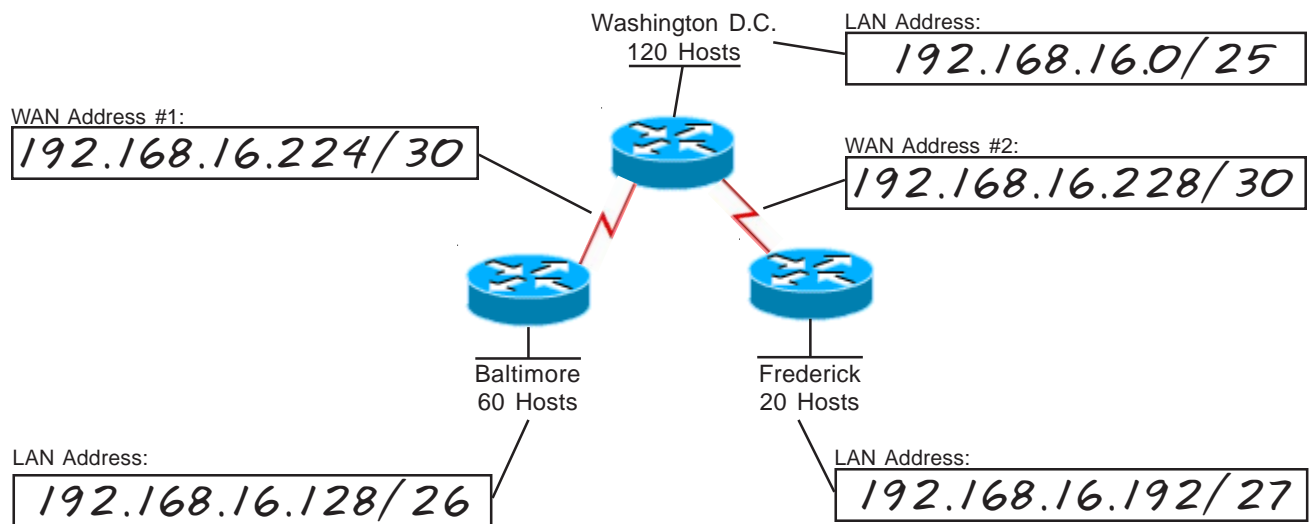
VLSM Addressing

Box Method

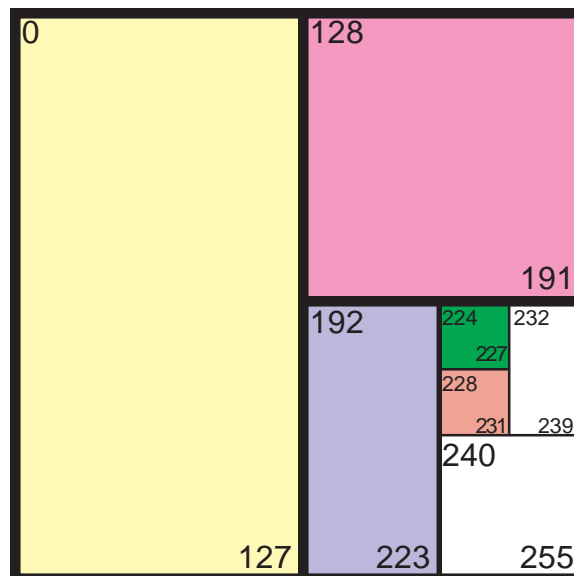
(Sample)

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.

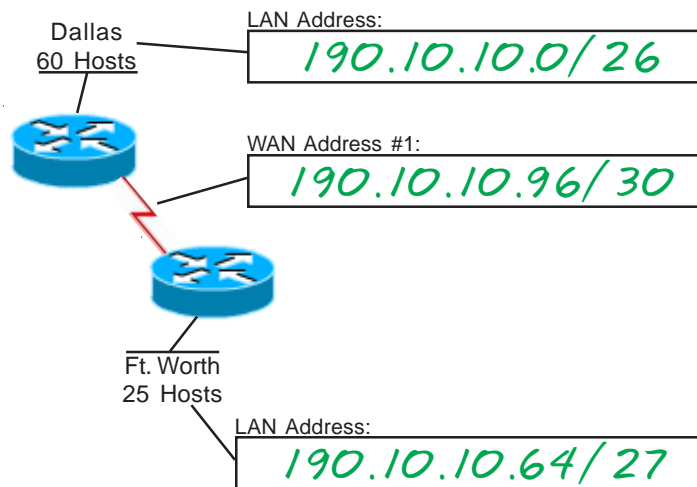


VLSM Addressing

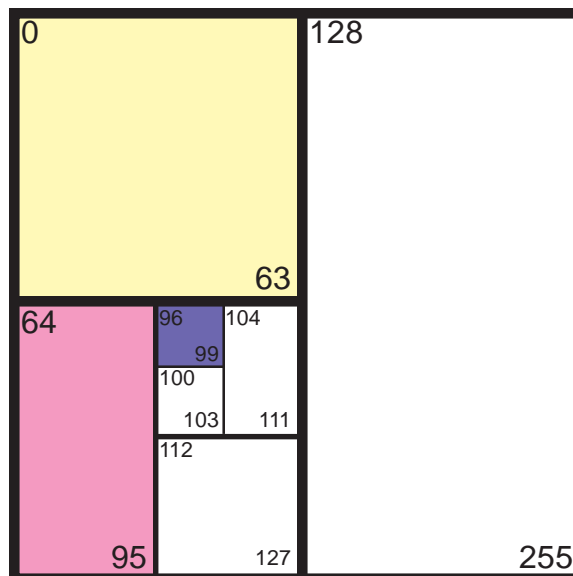
Box Method

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.

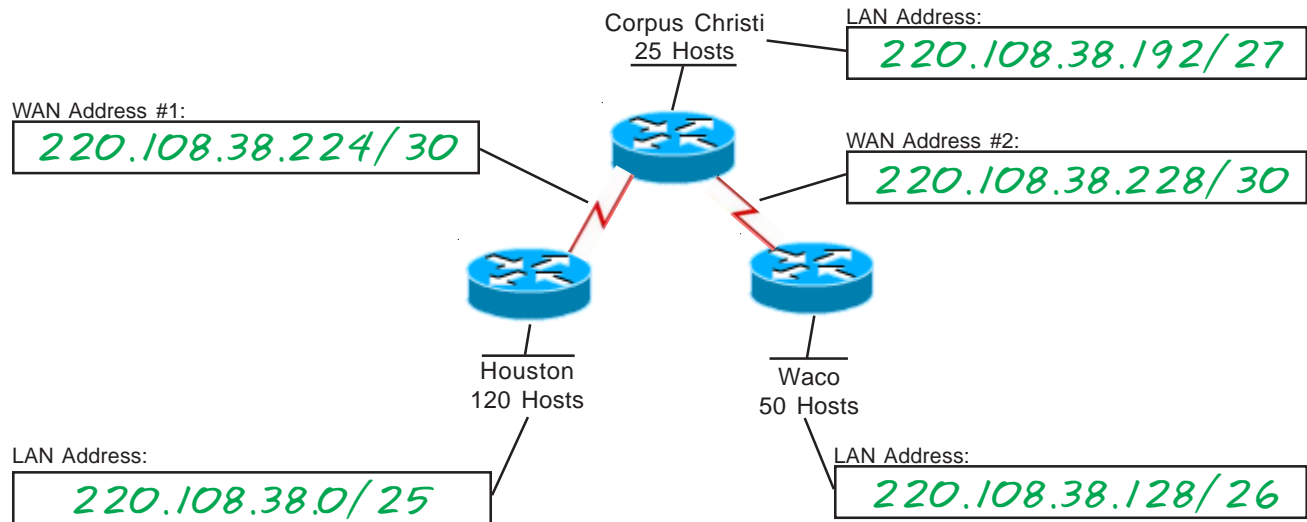


VLSM Addressing

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.

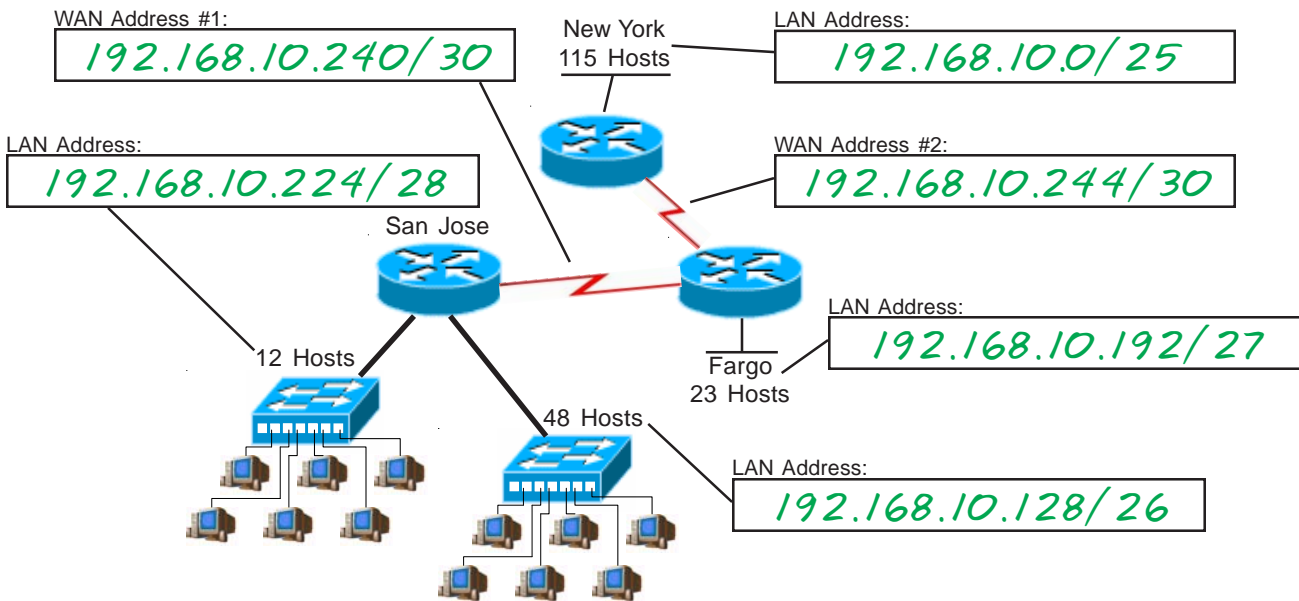
0	8	32	40	128	136	160	168	
	3	11	35	43	131	139	163	171
4	12	36	44	132	140	164	172	
	7	15	39	47	135	143	167	175
16	24	48	56	144	152	176	184	
	19	27	51	59	147	155	179	187
20	28	52	60	148	156	180	188	
	23	31	55	63	151	159	183	191
64	72	96	104	192	200	224	232	
	67	75	99	107	195	203	227	235
68	76	100	108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

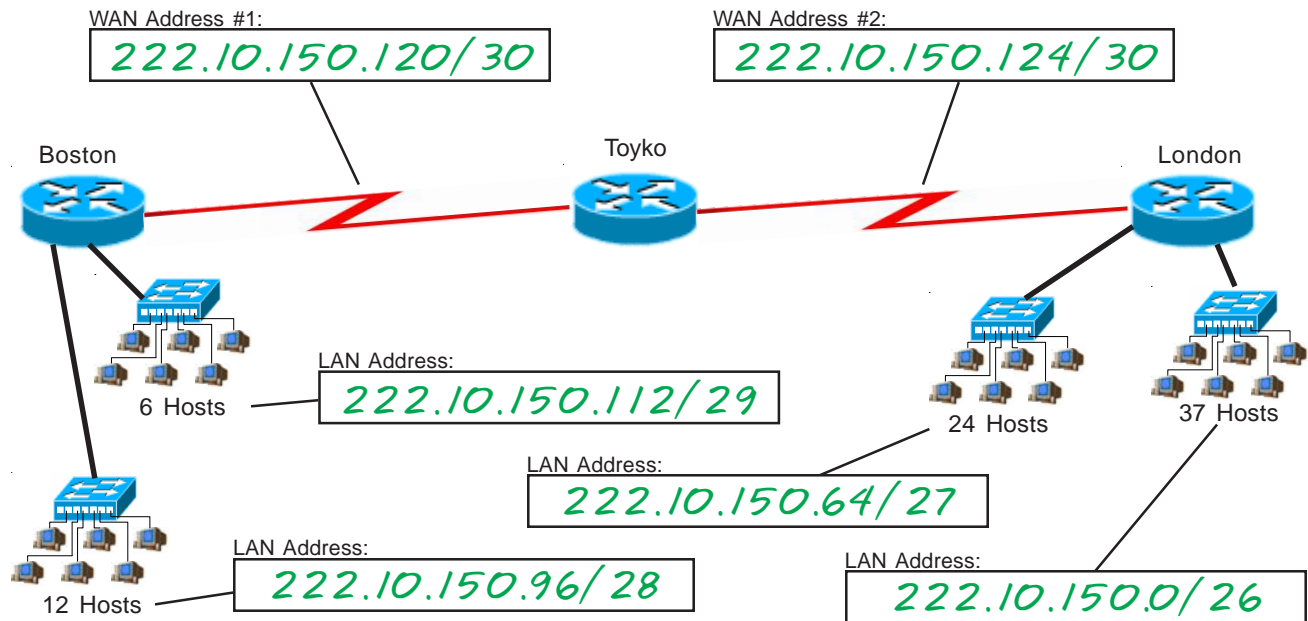
0	8	32	40	128	136	160	168	
	3	11	35	43	131	139	163	171
4	12	36	44	132	140	164	172	
	7	15	39	47	135	143	167	175
16	24	48	56	144	152	176	184	
	19	27	51	59	147	155	179	187
20	28	52	60	148	156	180	188	
	23	31	55	63	151	159	183	191
64	72	96	104	192	200	224	232	
	67	75	99	107	195	203	227	235
68	76	100	108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

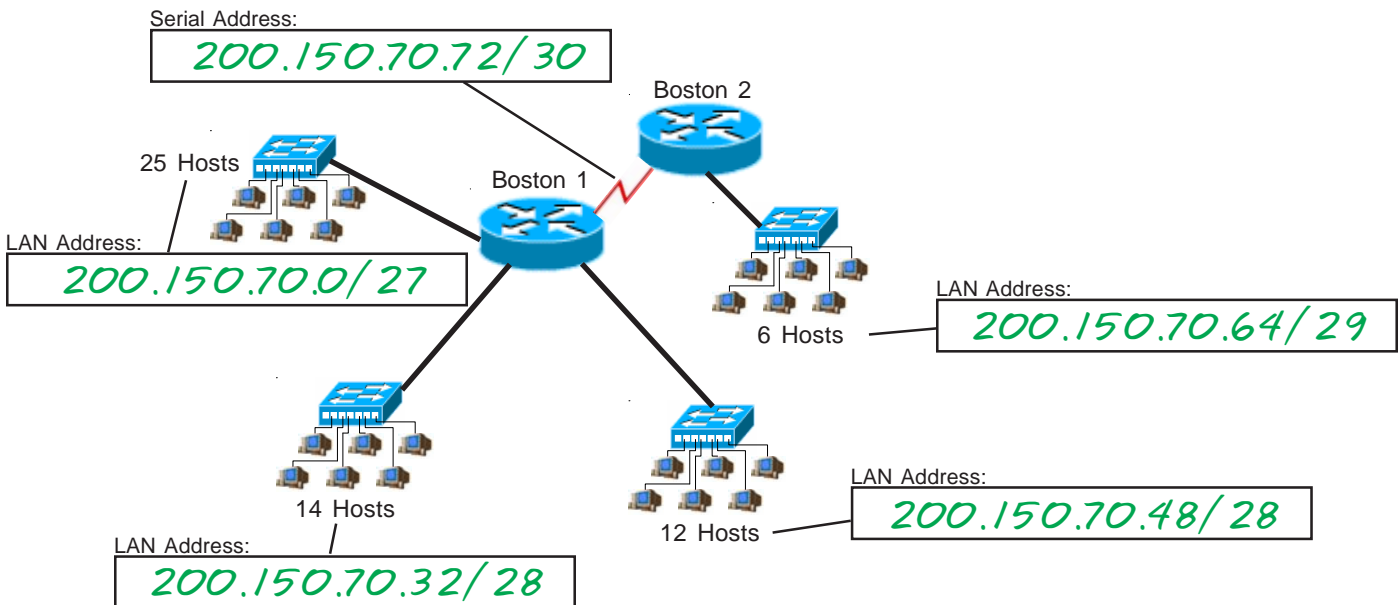
0	32	128	160
31	63	159	191
64	96	192	224
95	111	223	255
	112		
	119		
	120		
	123		
	124		
	127		

VLSM Addressing

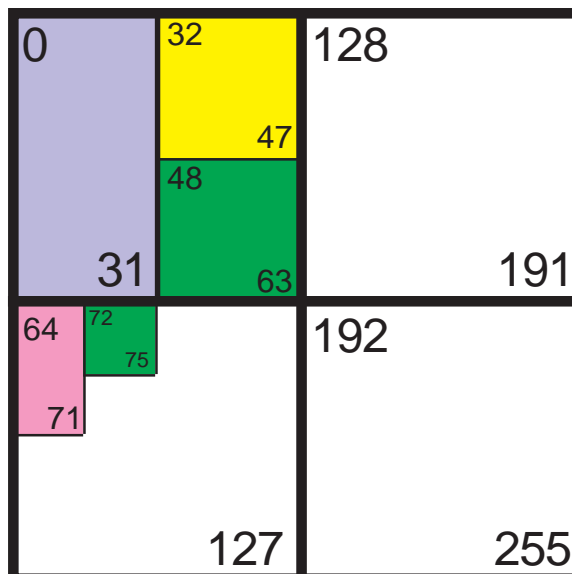
Box Method

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.

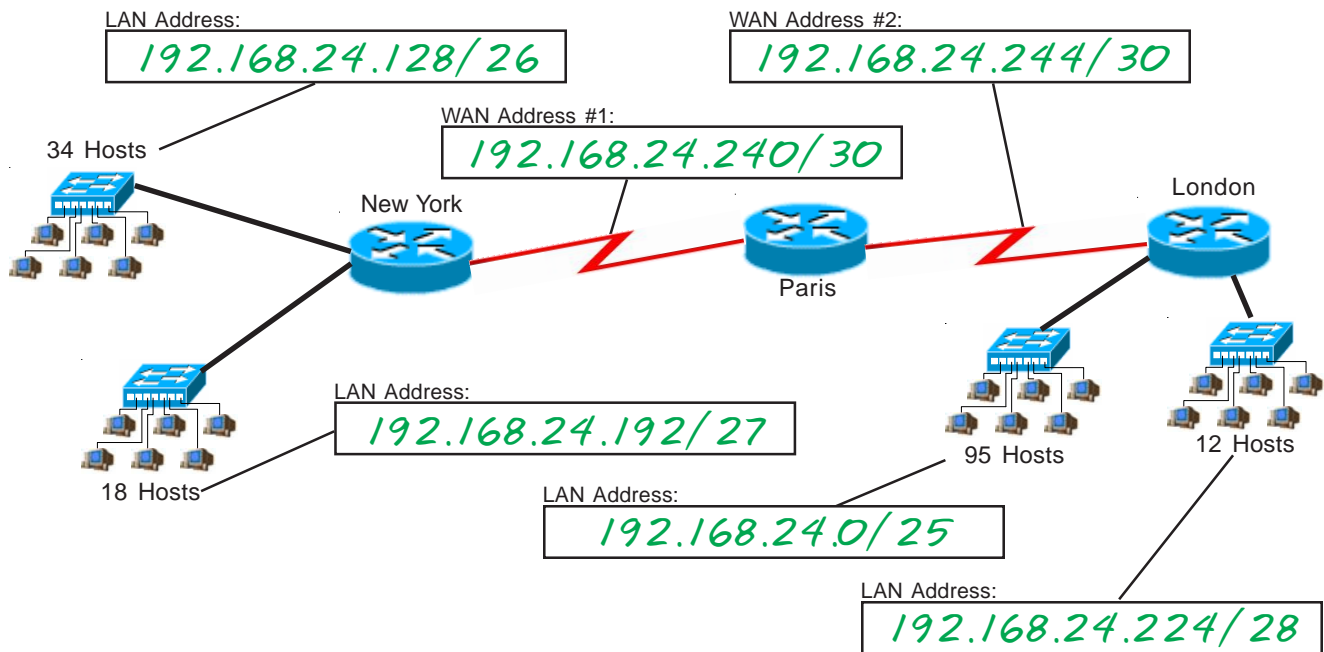


VLSM Addressing

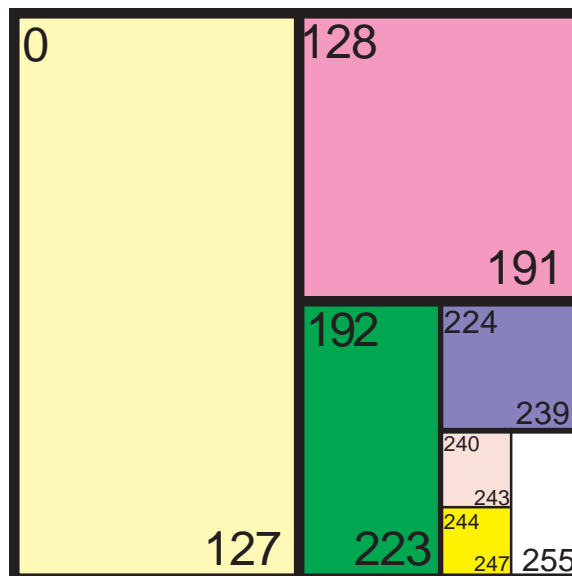
Box Method

Problem 8

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



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

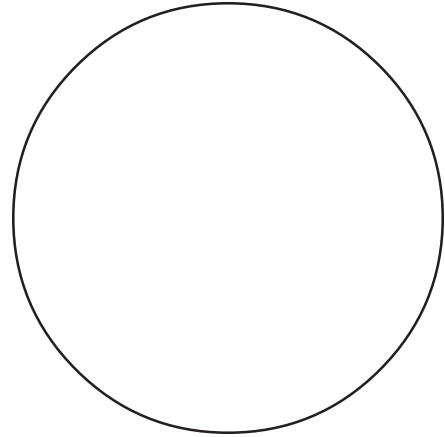


Visualizing Subnets Using The Circle Method

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

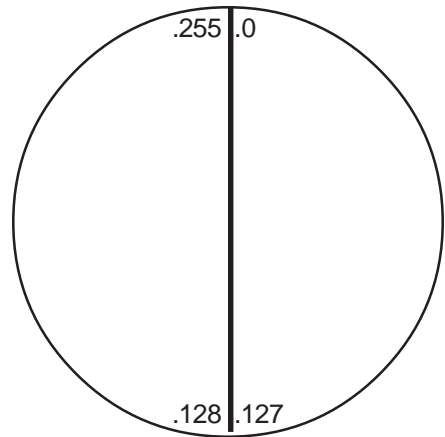
Start with a circle. The whole circle is a single subnet comprised of 256 addresses.

/24
255.255.255.0
256 Hosts
1 Subnet



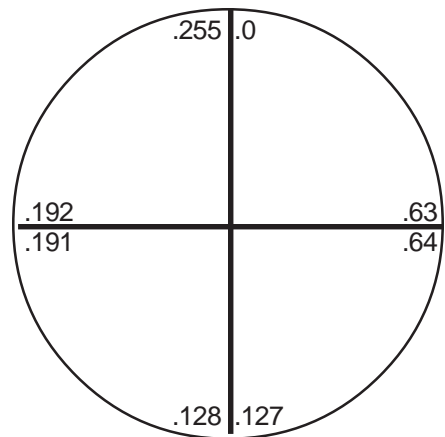
Split the circle in half and you get two subnets with 128 addresses.

/25
255.255.255.128
128 Hosts
2 Subnets



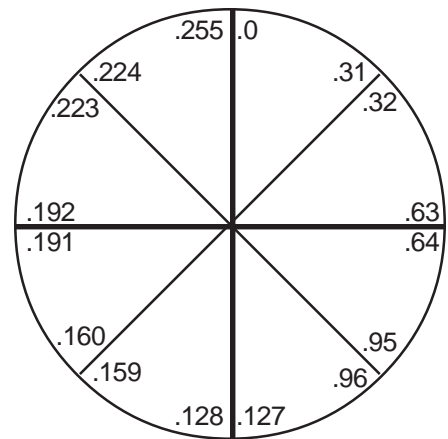
Divide the circle into quarters and you get four subnets with 64 addresses.

/26
255.255.255.192
64 Hosts
4 Subnets



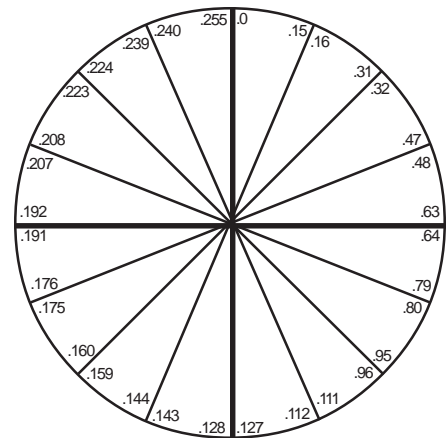
Split each quarter and you get eight subnets with 32 addresses.

/27
255.255.255.224
32 Hosts
8 Subnets



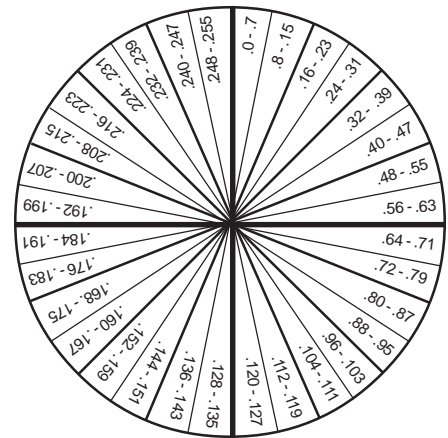
Split the boxes in half again and you get sixteen subnets with sixteen addresses.

/28
255.255.255.240
16 Hosts
16 Subnets



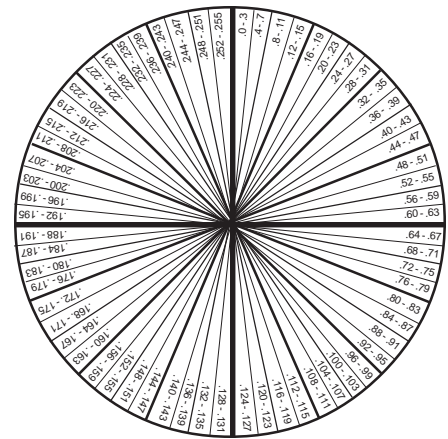
The next split gives you thirty two subnets with eight addresses.

/29
255.255.255.248
8 Hosts
32 Subnets



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

/30
255.255.255.252
4 Hosts
64 Subnets



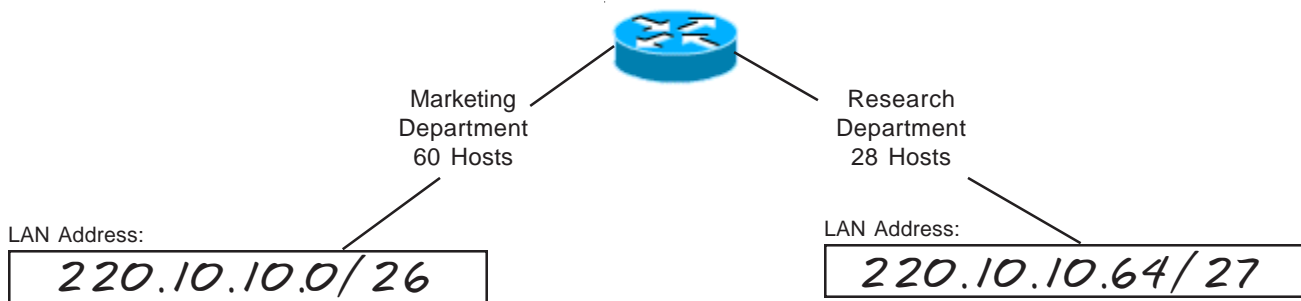
VLSM Addressing

Circle Method

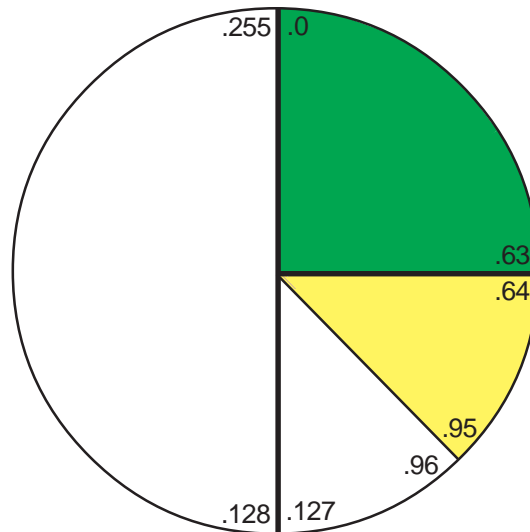
(Sample)

Problem 9

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



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



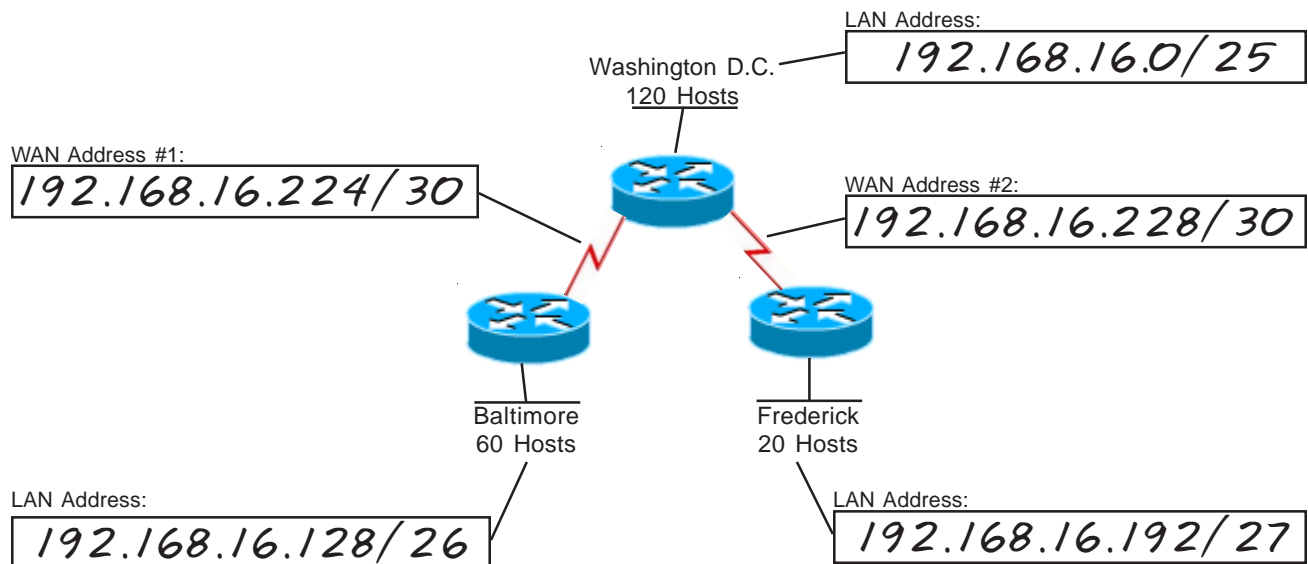
VLSM Addressing

Circle Method

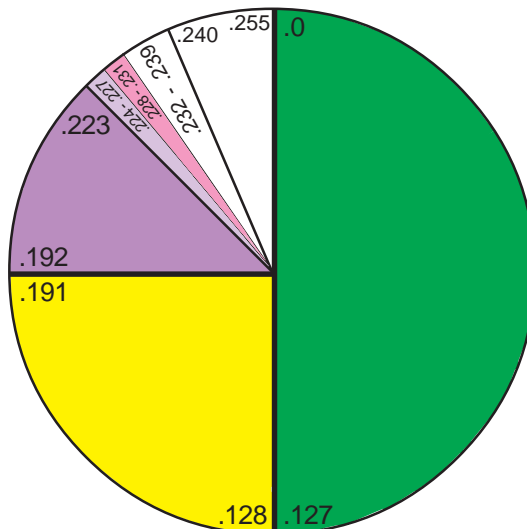
(Sample)

Problem 10

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



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

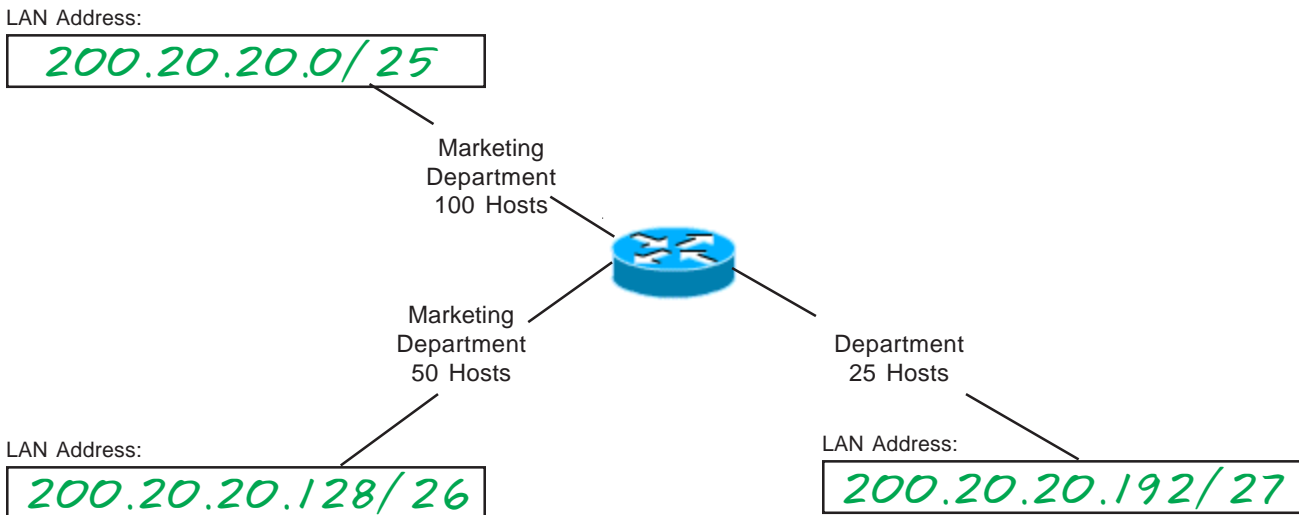


VLSM Addressing

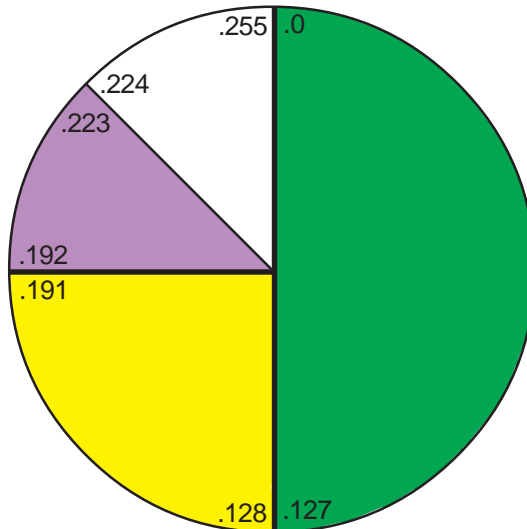
Circle Method

Problem 11

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



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

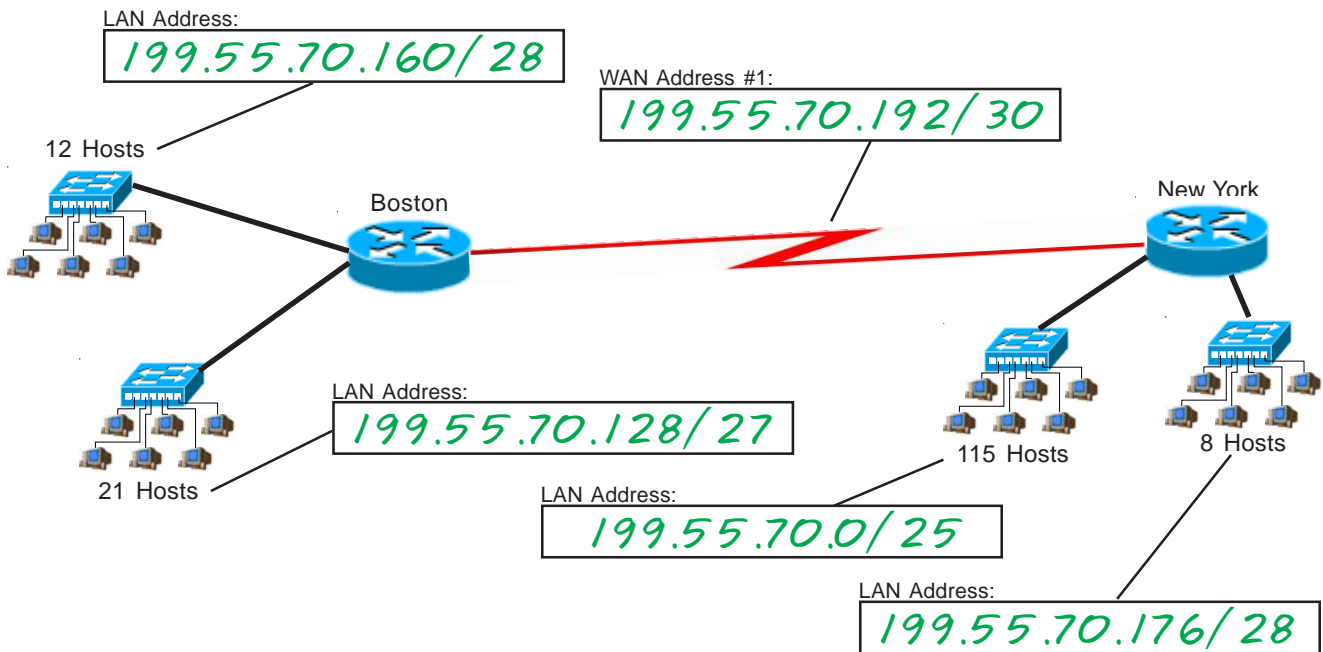


VLSM Addressing

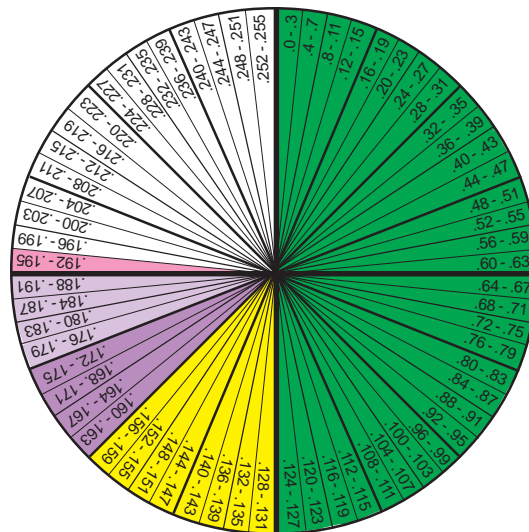
Circle Method

Problem 12

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



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

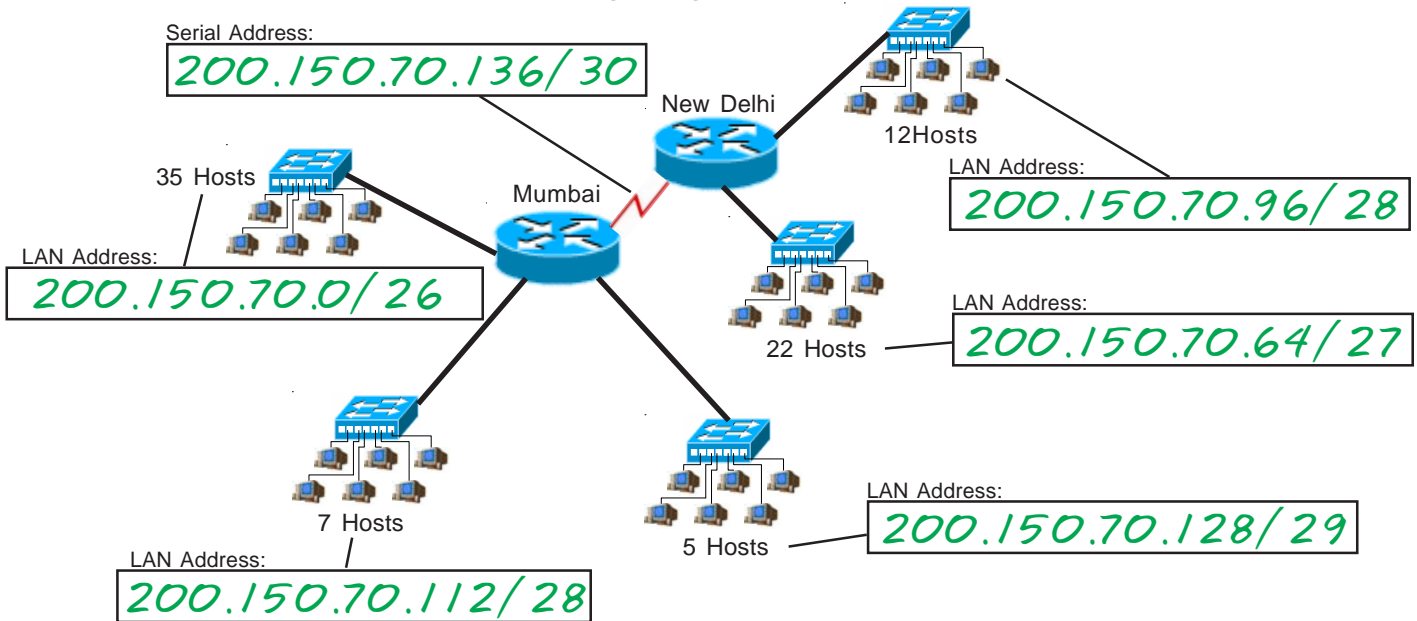


VLSM Addressing

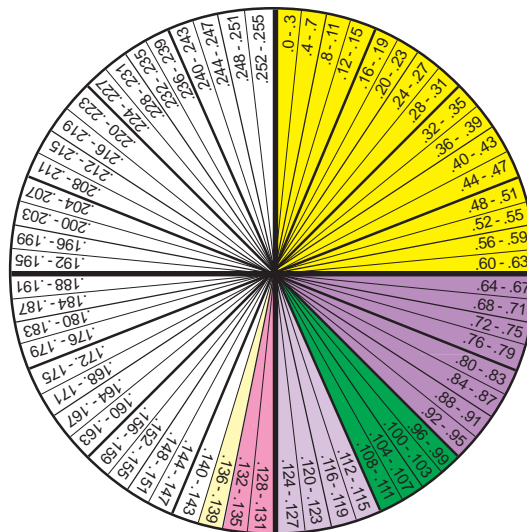
Circle Method

Problem 13

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



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

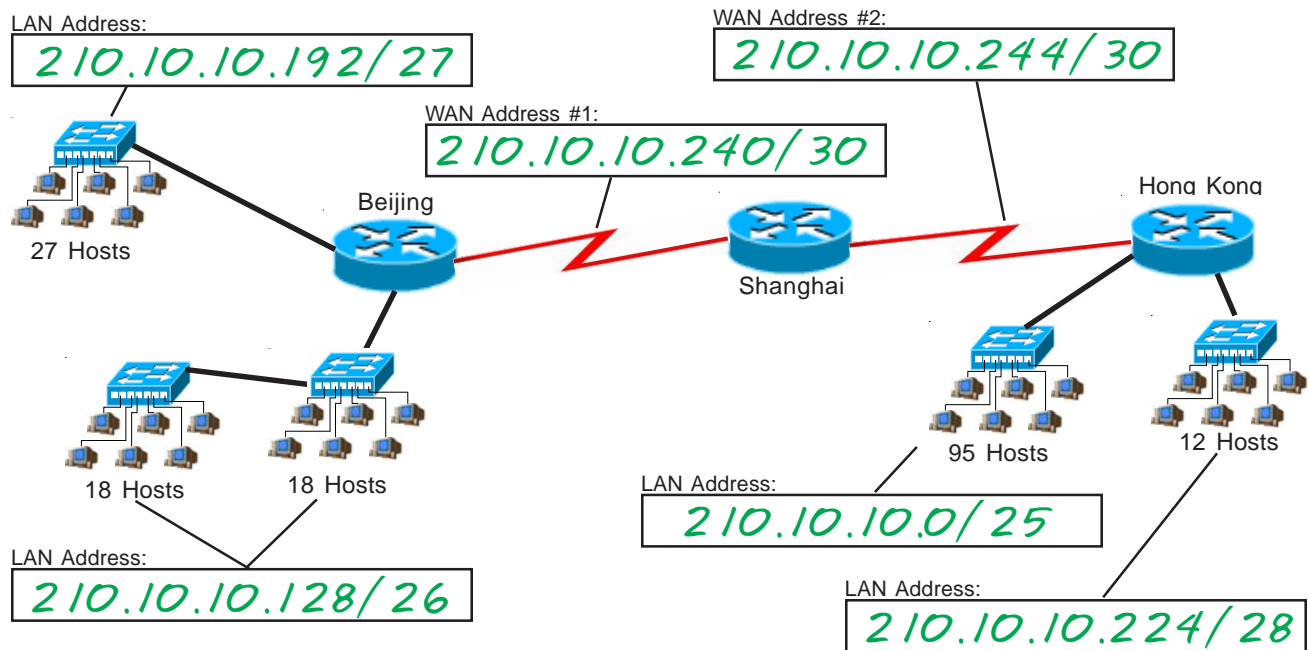


VLSM Addressing

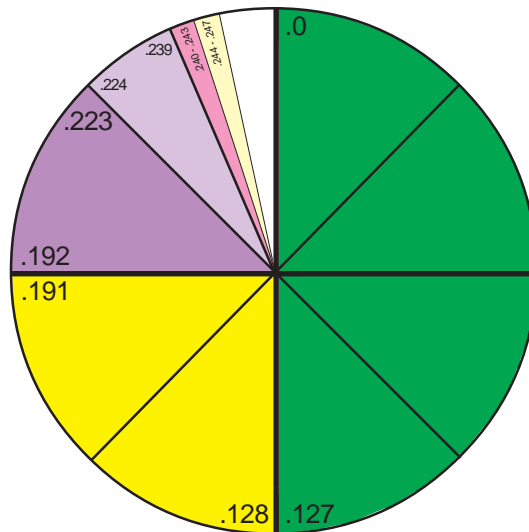
Circle Method

Problem 14

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



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

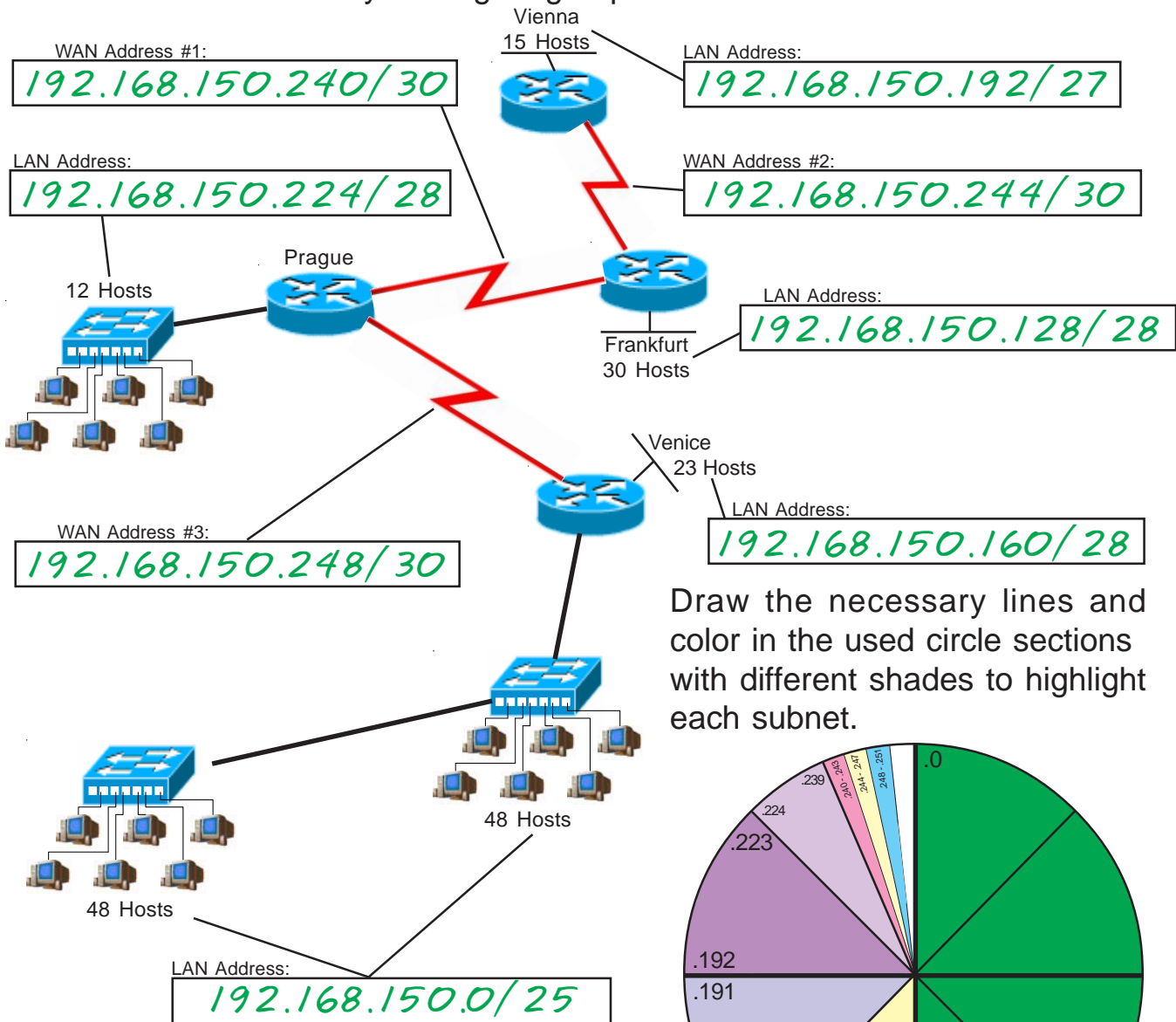


VLSM Addressing

Circle Method

Problem 15

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

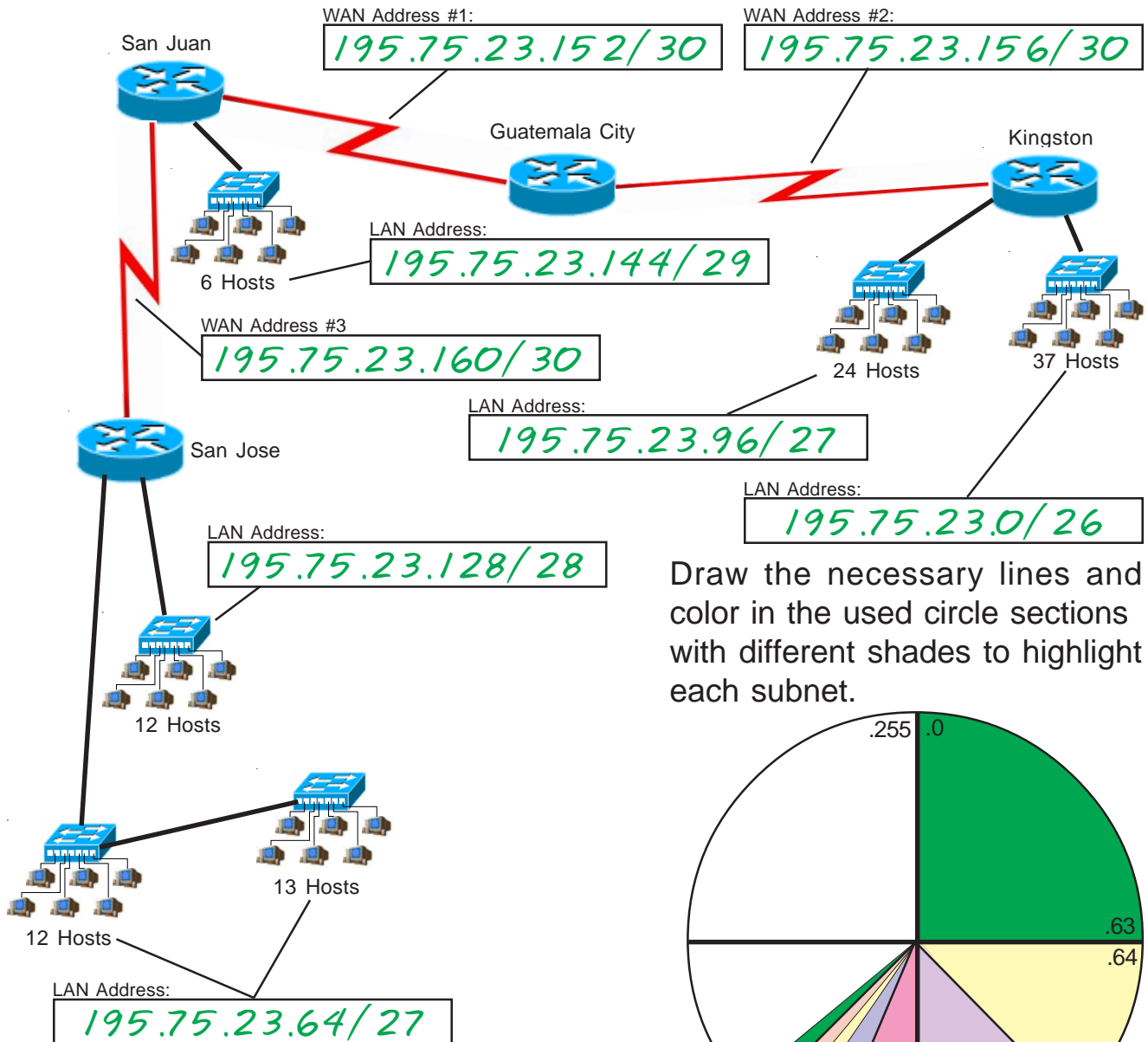


VLSM Addressing

Circle Method

Problem 16

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



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

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.

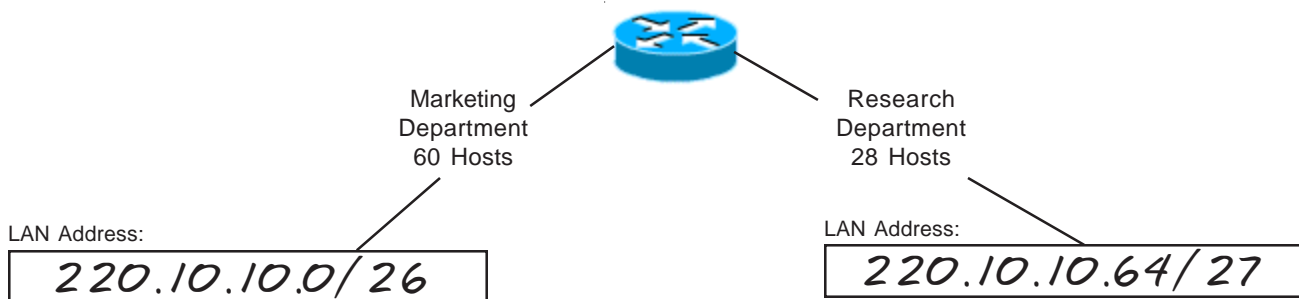
VLSM Addressing

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

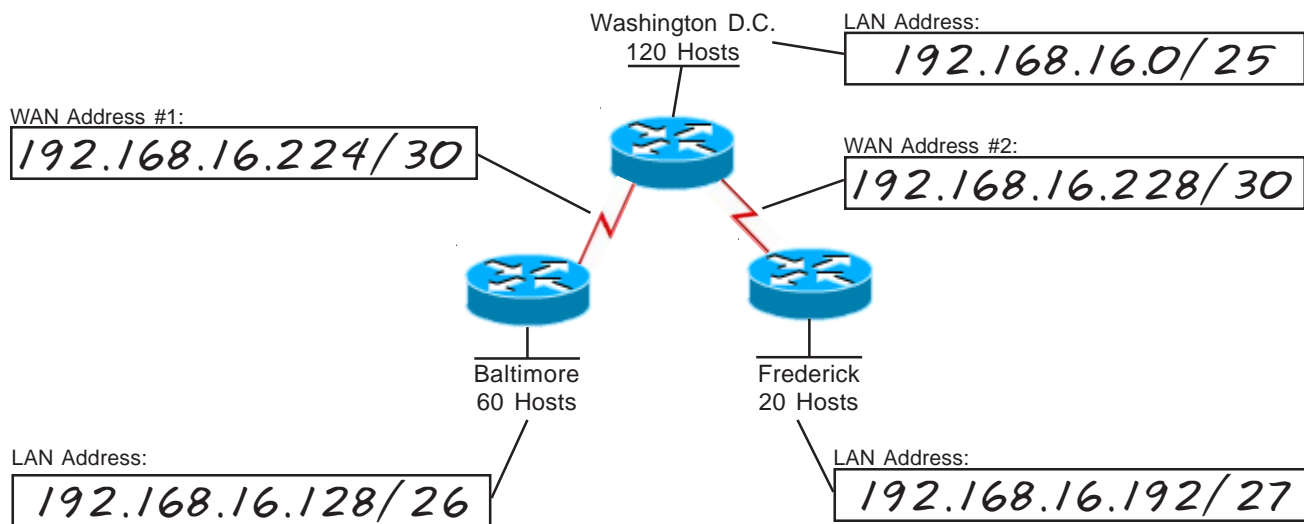
VLSM Addressing

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)

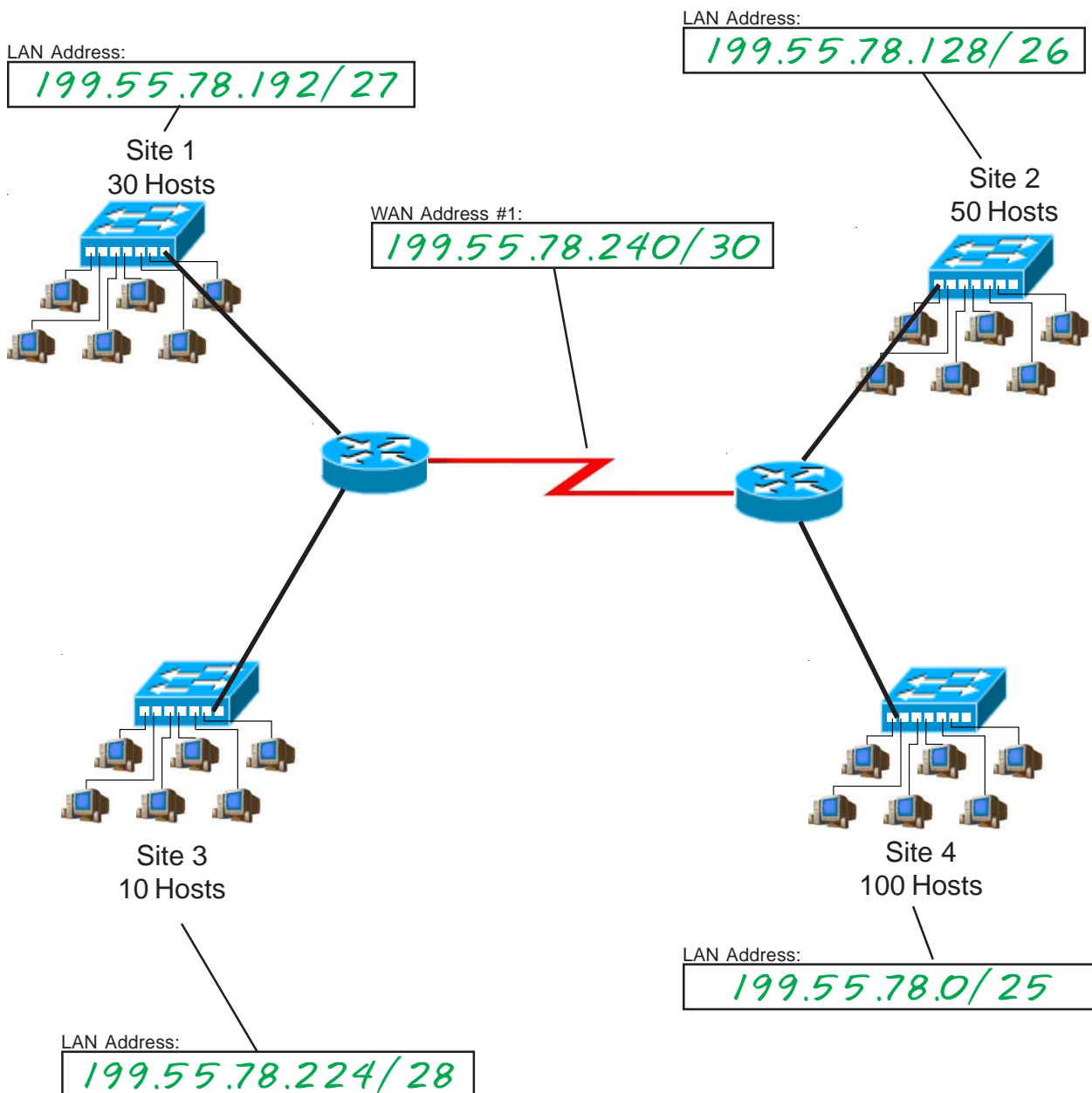
/24 255.255.255.0 256 Hosts	/25 255.255.255.128 128 Hosts	/26 255.255.255.192 64 Hosts	/27 255.255.255.224 32 Hosts	/28 255.255.255.240 16 Hosts	/29 255.255.255.248 8 Hosts	/30 255.255.255.252 4 Hosts	
0 - 255	0-127	0-63	0-31	0-15	0-7	0-3	
					8-15	4-7	
				16-31	8-11	12-15	
					16-19	20-23	
			32-63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

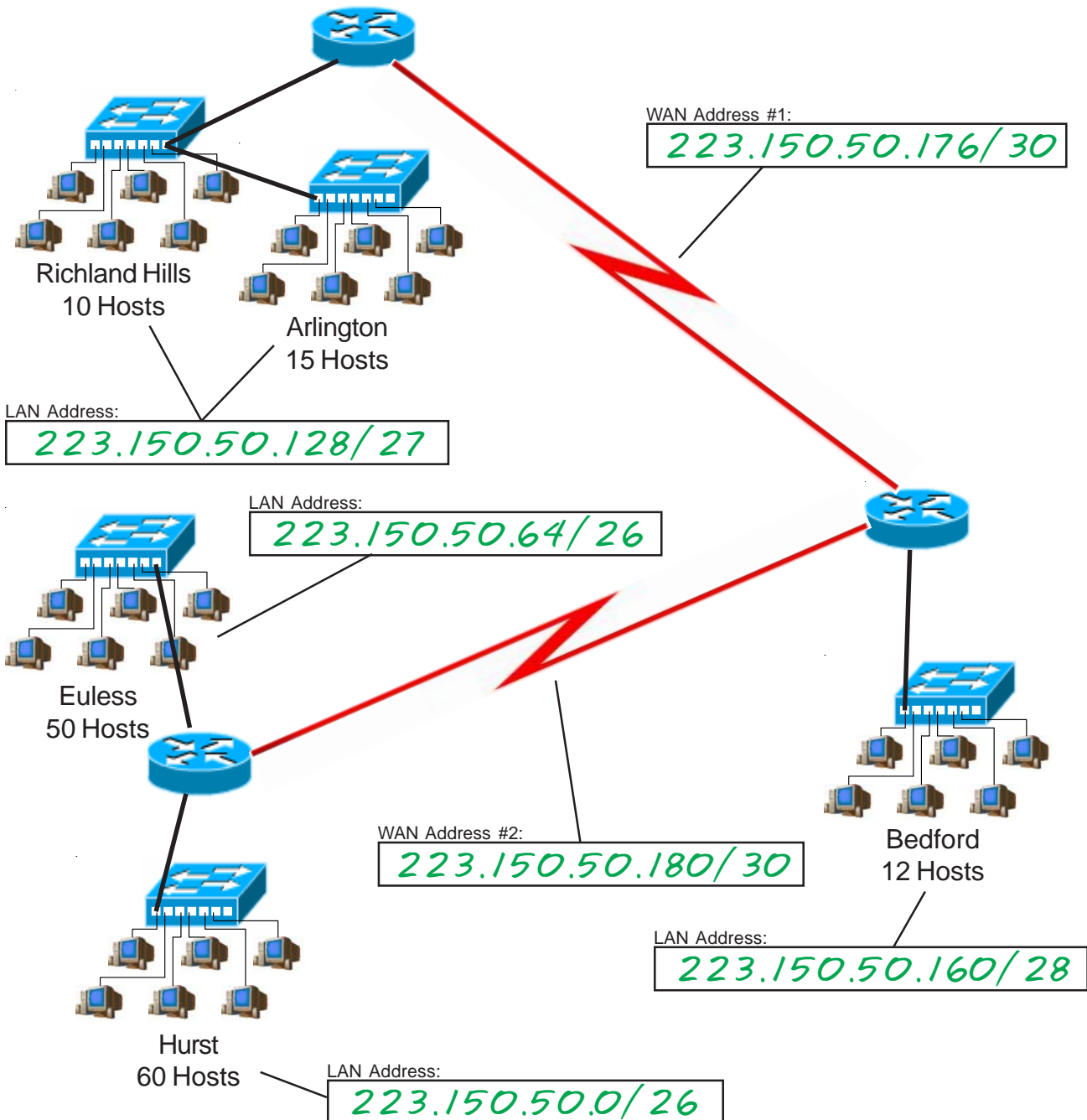
/24 255.255.255.0 256 Hosts	/25 255.255.255.128 128 Hosts	/26 255.255.255.192 64 Hosts	/27 255.255.255.224 32 Hosts	/28 255.255.255.240 16 Hosts	/29 255.255.255.248 8 Hosts	/30 255.255.255.252 4 Hosts		
0 - 255	0-127	0-63	0-31	0-15	0-7	0-3		
					8-15	4-7	8-11	
				16-31	16-23	12-15	16-19	
					24-31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

VLSM Addressing

VLSM Chart Method

Problem 20

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



Class C Addresses

VLSM Chart 24-30 Bits (4th octet)

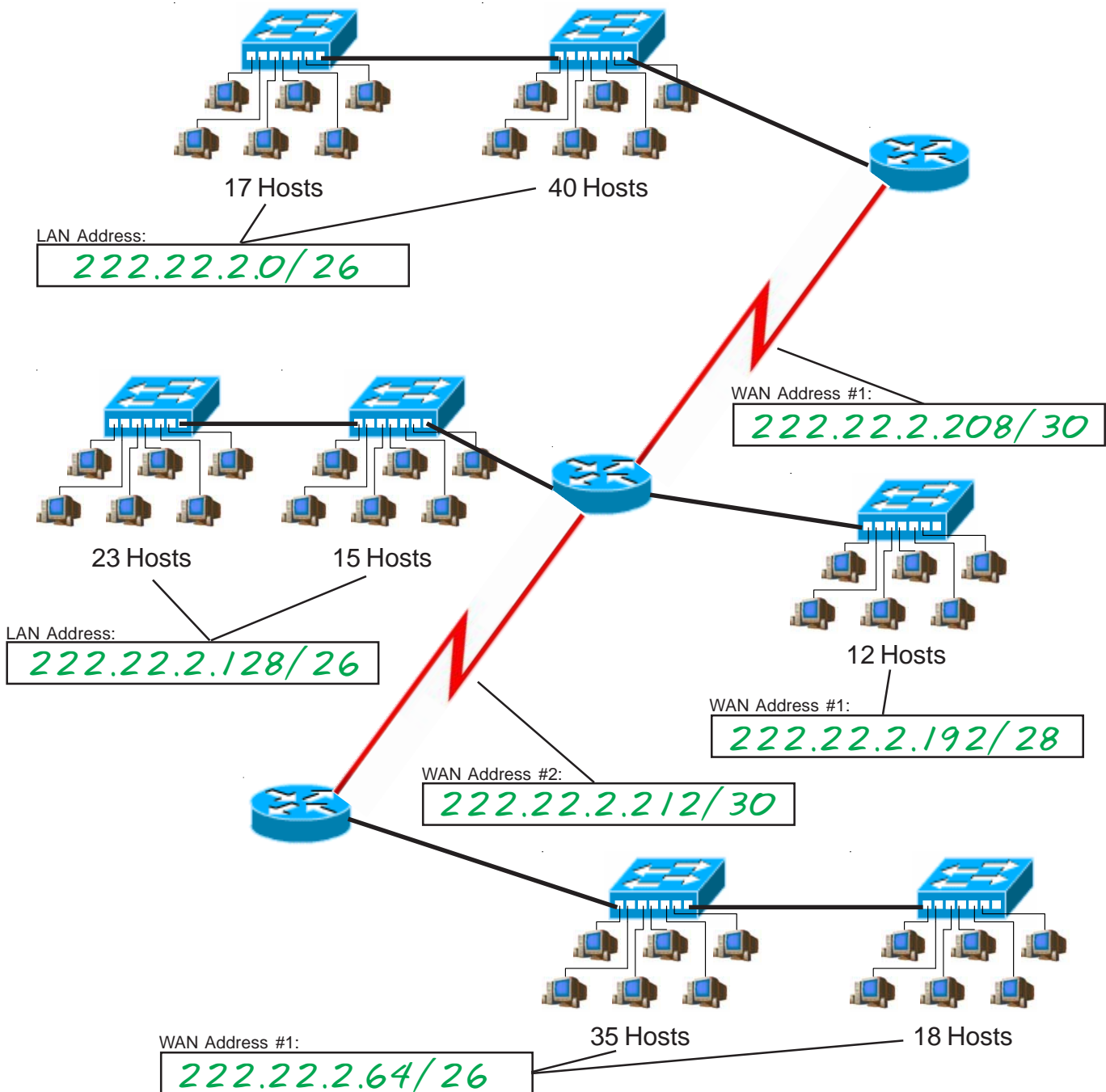
/24 255.255.255.0 256 Hosts	/25 255.255.255.128 128 Hosts	/26 255.255.255.192 64 Hosts	/27 255.255.255.224 32 Hosts	/28 255.255.255.240 16 Hosts	/29 255.255.255.248 8 Hosts	/30 255.255.255.252 4 Hosts
0 - 255	0-127	0-63	0-31	0-15	0-7	0-3
					4-7	4-7
				8-15	8-11	
				12-15	12-15	
			16-31	16-19	16-19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

VLSM Addressing

VLSM Chart Method

Problem 21

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



Class C Addresses

VLSM Chart 24-30 Bits (4th octet)

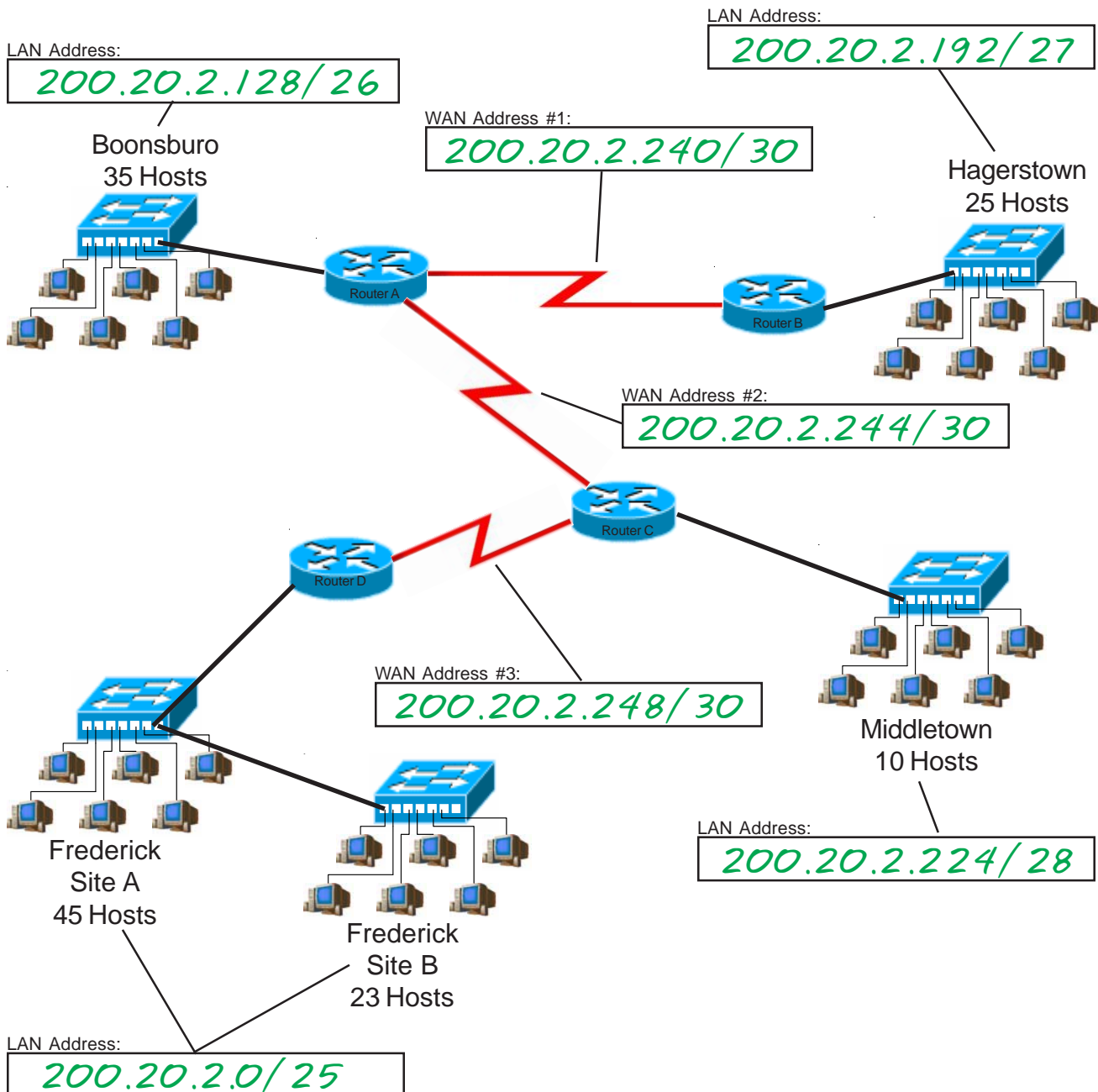
/24 255.255.255.0 256 Hosts	/25 255.255.255.128 128 Hosts	/26 255.255.255.192 64 Hosts	/27 255.255.255.224 32 Hosts	/28 255.255.255.240 16 Hosts	/29 255.255.255.248 8 Hosts	/30 255.255.255.252 4 Hosts	
0 - 255	0-127	0-63	0-31	0-15	0-7	0-3	
					8-15	4-7	
				16-31	8-11	12-15	
					16-23	16-19	
			32-63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

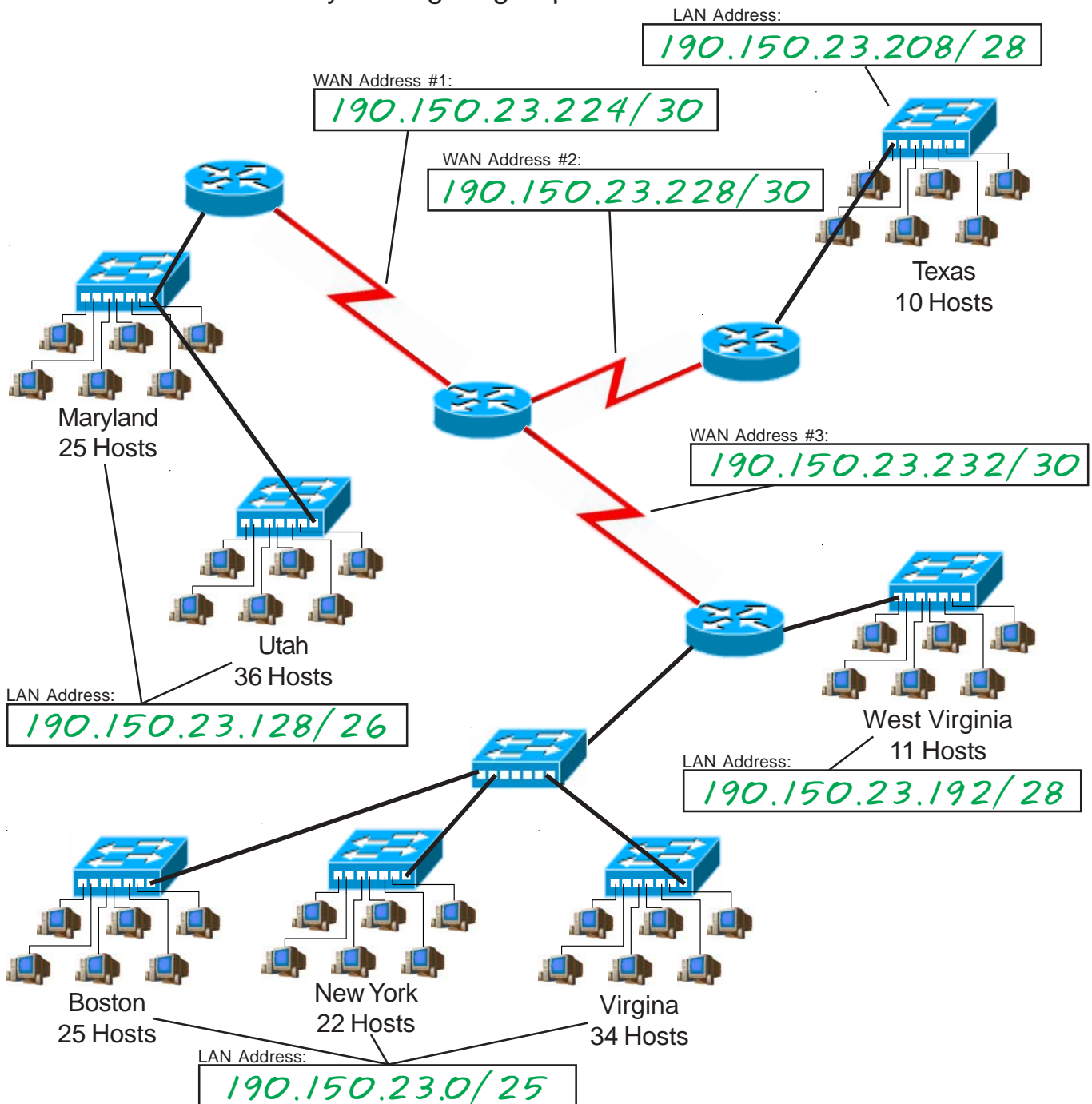
/24 255.255.255.0 256 Hosts	/25 255.255.255.128 128 Hosts	/26 255.255.255.192 64 Hosts	/27 255.255.255.224 32 Hosts	/28 255.255.255.240 16 Hosts	/29 255.255.255.248 8 Hosts	/30 255.255.255.252 4 Hosts
0 - 255	0-127	0-63	0-31	0-15	0-7	0-3
					8-15	4-7
						8-11
						12-15
			16-31	16-23	16-19	
					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	
				56-63	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		

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)

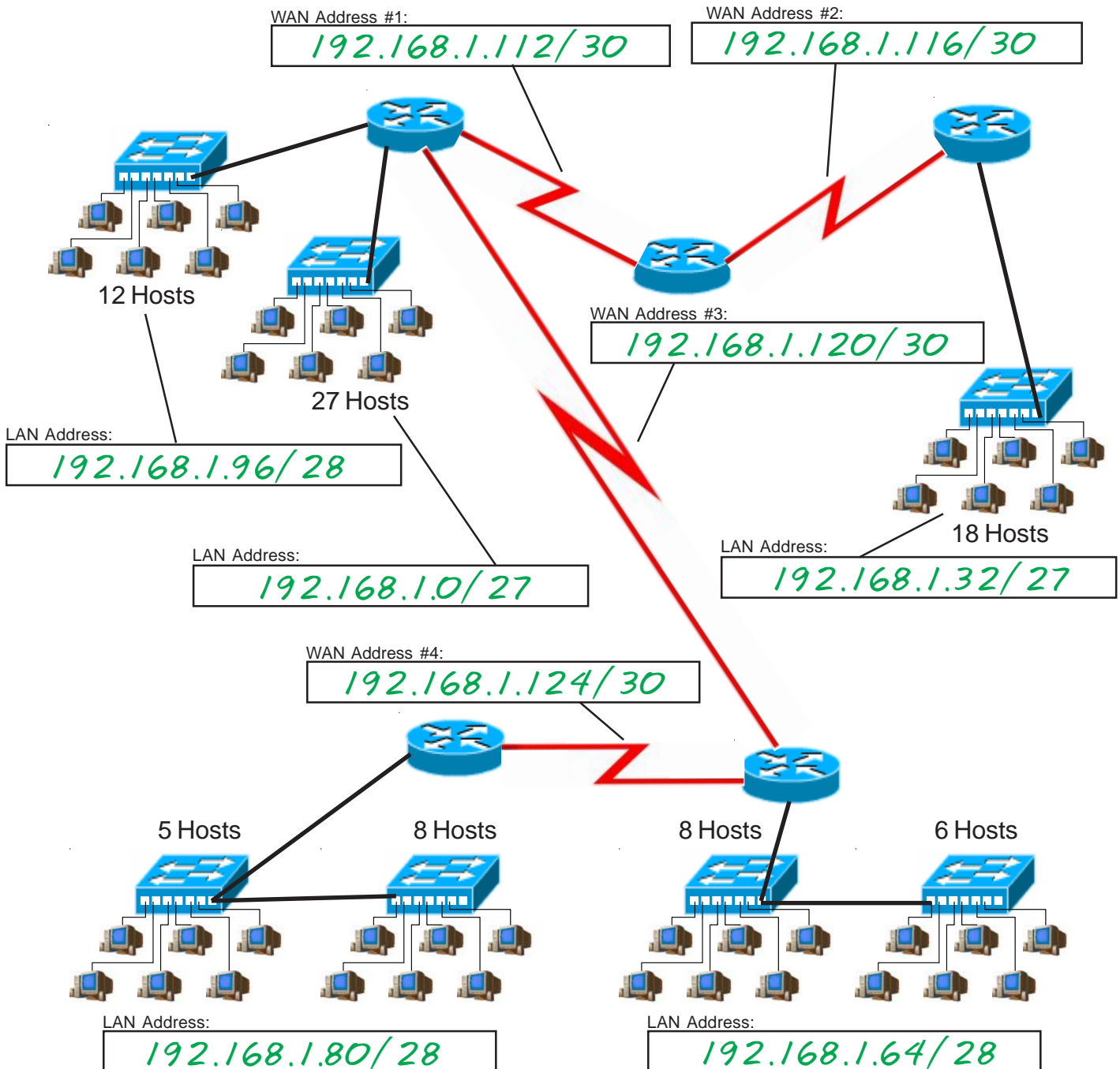
/24 255.255.255.0 256 Hosts	/25 255.255.255.128 128 Hosts	/26 255.255.255.192 64 Hosts	/27 255.255.255.224 32 Hosts	/28 255.255.255.240 16 Hosts	/29 255.255.255.248 8 Hosts	/30 255.255.255.252 4 Hosts
0 - 255	0-127	0-63	0-31	0-15	0-7	0-3
					8-15	4-7
						8-11
						12-15
			16-31	16-23	16-19	
					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	160-167	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	192-195			
			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			

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

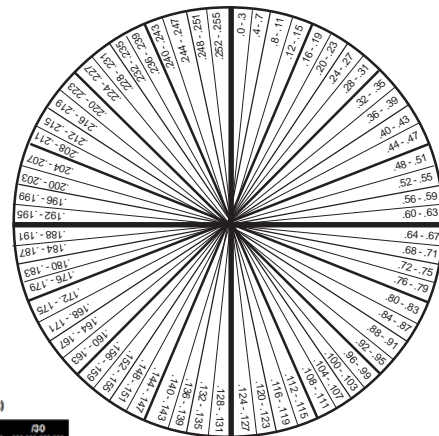
VLSM Chart 24-30 Bits (4th octet)

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

Practical VLSM Problems

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

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

VLSM 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
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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	222.37.34.0	/25	222.37.34.1	222.37.34.126	222.37.34.127
2	222.37.34.128	/26	222.37.34.129	222.37.34.190	222.37.34.191
3	222.37.34.192	/27	222.37.34.193	222.37.34.222	222.37.34.223
4	222.37.34.224	/28	222.37.34.225	222.37.34.238	222.37.34.239
5	222.37.34.240	/29	222.37.34.241	222.37.34.246	222.37.34.247
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13					
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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	192.168.10.0	/27	192.168.10.1	192.168.10.30	192.168.10.31
2	192.168.10.32	/29	192.168.10.33	192.168.10.38	192.168.10.39
3	192.168.10.40	/29	192.168.10.41	192.168.10.46	192.168.10.47
4	192.168.10.48	/30	192.168.10.49	192.168.10.50	192.168.10.51
5	192.168.10.52	/30	192.168.10.53	192.168.10.54	192.168.10.55
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8					
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12					
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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	223.145.75.0	/25	223.145.75.1	223.145.75.126	223.145.75.127
2	223.145.75.128	/27	223.145.75.129	223.145.75.158	223.145.75.159
3	223.145.75.160	/27	223.145.75.161	223.145.75.190	223.145.75.191
4	223.145.75.192	/27	223.145.75.193	223.145.75.222	223.145.75.223
5	223.145.75.224	/28	223.145.75.225	223.145.75.238	223.145.75.239
6	223.145.75.240	/29	223.145.75.241	223.145.75.246	223.145.75.247
7	223.145.75.248	/29	223.145.75.249	223.145.75.254	223.145.75.255
8					
9					
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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	192.168.250.0	/26	92.168.250.1	92.168.250.62	92.168.250.63
2	92.168.250.64	/27	92.168.250.65	92.168.250.94	92.168.250.95
3	92.168.250.96	/27	92.168.250.97	92.168.250.126	92.168.250.127
4	92.168.250.128	/27	92.168.250.129	92.168.250.158	92.168.250.159
5	92.168.250.160	/27	92.168.250.161	92.168.250.190	92.168.250.191
6	92.168.250.192	/27	92.168.250.193	92.168.250.222	92.168.250.223
7					
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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	192.168.10.0	/25	192.168.10.1	192.168.10.126	192.168.10.127
2	192.168.10.128	/26	192.168.10.129	192.168.10.190	192.168.10.191
3	192.168.10.192	/28	192.168.10.193	192.168.10.206	192.168.10.207
4	192.168.10.208	/29	192.168.10.209	192.168.10.214	192.168.10.215
5	192.168.10.216	/30	192.168.10.217	192.168.10.218	192.168.10.219
6	192.168.10.220	/30	192.168.10.221	192.168.10.222	192.168.10.223
7	192.168.10.224	/30	192.168.10.225	192.168.10.226	192.168.10.227
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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	192.168.12.0	/25	192.168.12.1	192.168.12.126	192.168.12.127
2	192.168.12.128	/27	192.168.12.129	192.168.12.158	192.168.12.159
3	192.168.12.160	/29	192.168.12.161	192.168.12.166	192.168.12.167
4	192.168.12.168	/29	192.168.12.169	192.168.12.174	192.168.12.175
5					
6					
7					
8					
9					
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11					
12					
13					
14					

VLSM Addressing

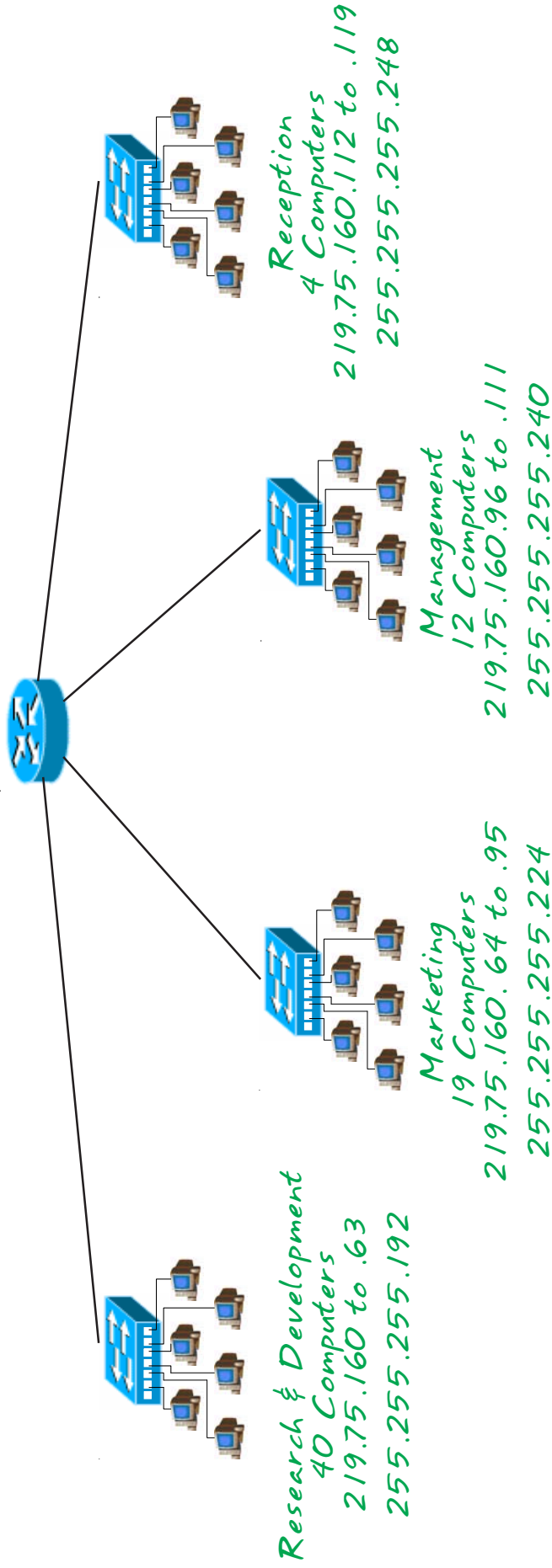
Problem 33

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	219.75.160.0	/26	219.75.160.1	219.75.160.62	219.75.160.63
2	219.75.160.64	/27	219.75.160.65	219.75.160.94	219.75.160.95
3	219.75.160.96	/28	219.75.160.97	219.75.160.110	219.75.160.111
4	219.75.160.112	/29	219.75.160.113	219.75.160.118	219.75.160.119
5					
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Problem 33 - Detailed Map

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



VLSM Addressing

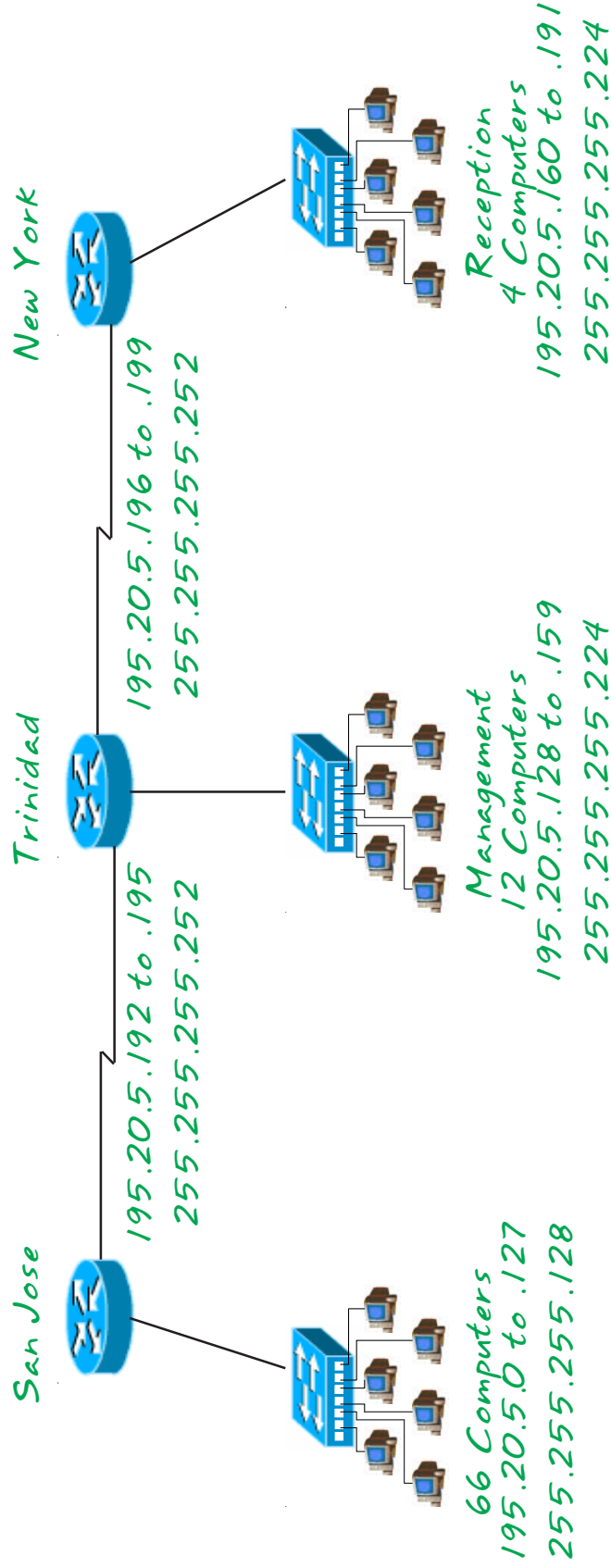
Problem 34

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

Subnet	Subnet Address	Subnet Mask (X)	First Usable Host	Last Usable Host	Broadcast Address
1	195.20.5.0	/25	195.20.5.1	195.20.5.126	195.20.5.127
2	195.20.5.128	/27	195.20.5.129	195.20.5.158	195.20.5.159
3	195.20.5.160	/27	195.20.5.161	195.20.5.190	195.20.5.191
4	195.20.5.192	/30	195.20.5.193	195.20.5.194	195.20.5.195
5	195.20.5.196	/30	195.20.5.197	195.20.5.198	195.20.5.199
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)

Hosts	IP	Mask	Network	First IP	Last IP
8-15	10.0.0.0	8	10.0.0.0	10.0.0.0	10.0.0.255
8-9	10.0.0.0	9	10.0.0.0	10.0.0.0	10.0.0.127
8-10	10.0.0.0	10	10.0.0.0	10.0.0.0	10.0.0.63
8-11	10.0.0.0	11	10.0.0.0	10.0.0.0	10.0.0.31
8-12	10.0.0.0	12	10.0.0.0	10.0.0.0	10.0.0.15
8-13	10.0.0.0	13	10.0.0.0	10.0.0.0	10.0.0.7
8-14	10.0.0.0	14	10.0.0.0	10.0.0.0	10.0.0.3
8-15	10.0.0.0	15	10.0.0.0	10.0.0.0	10.0.0.1

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

Hosts	IP	Mask	Network	First IP	Last IP
16-23	10.0.0.0	16	10.0.0.0	10.0.0.0	10.0.255.255
16-17	10.0.0.0	17	10.0.0.0	10.0.0.0	10.0.127.255
16-18	10.0.0.0	18	10.0.0.0	10.0.0.0	10.0.63.255
16-19	10.0.0.0	19	10.0.0.0	10.0.0.0	10.0.31.255
16-20	10.0.0.0	20	10.0.0.0	10.0.0.0	10.0.15.255
16-21	10.0.0.0	21	10.0.0.0	10.0.0.0	10.0.7.255
16-22	10.0.0.0	22	10.0.0.0	10.0.0.0	10.0.3.255
16-23	10.0.0.0	23	10.0.0.0	10.0.0.0	10.0.1.255

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

Hosts	IP	Mask	Network	First IP	Last IP
24-30	10.0.0.0	24	10.0.0.0	10.0.0.0	10.0.0.255
24-25	10.0.0.0	25	10.0.0.0	10.0.0.0	10.0.0.127
24-26	10.0.0.0	26	10.0.0.0	10.0.0.0	10.0.0.63
24-27	10.0.0.0	27	10.0.0.0	10.0.0.0	10.0.0.31
24-28	10.0.0.0	28	10.0.0.0	10.0.0.0	10.0.0.15
24-29	10.0.0.0	29	10.0.0.0	10.0.0.0	10.0.0.7
24-30	10.0.0.0	30	10.0.0.0	10.0.0.0	10.0.0.3

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

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	192-223	192-207		192-195		
				196-199		
				200-203		
				204-207		
		208-223		208-211		
				212-215		
				216-219		
				220-223		
	224-255	224-239		224-227		
				228-231		
				232-235		
				236-239		
		240-255		240-243		
				244-247		
				248-251		
				252-255		

VLSM

with

Class A and B Addresses

Problem 36

Part 1 of 3

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

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

School System Address 172.32.0.0

Customer Name	Number of Addresses	Address Range (Include subnet & broadcast addresses)	CIDR
North High	2,400	<i>172.32.0.0 to 172.32.15.255</i>	<i>/20</i>
South High	2,000	<i>172.32.16.0 to 172.32.23.255</i>	<i>/21</i>
North Middle	1,200	<i>172.32.24.0 to 172.32.31.255</i>	<i>/21</i>
South Middle	1,000	<i>172.32.32.0 to 172.32.35.255</i>	<i>/22</i>
Central Elem.	550	<i>172.32.36.0 to 172.32.39.255</i>	<i>/22</i>
Southern Elem.	475	<i>172.32.40.0 to 172.32.41.255</i>	<i>/23</i>
Eastern Elem.	450	<i>172.32.42.0 to 172.32.43.255</i>	<i>/23</i>
Central Office	400	<i>172.32.44.0 to 172.32.45.255</i>	<i>/23</i>
Western Elem.	300	<i>172.32.46.0 to 172.32.47.255</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	8-11	4-5	2-3			
				16-31	16-19	6-7	8-9			
				24-31	20-23	10-11	12-13			
			32-63	32-39	12-15	14-15	16-17			
				40-47	16-19	18-19	20-21			
				48-63	20-23	22-23	24-25			
				56-63	24-27	26-27	28-29			
			64-127	64-95	64-79	64-71	32-39	28-31	30-31	32-33
						72-79	40-43	32-33	34-35	
					80-95	80-87	44-47	36-37	36-37	38-39
						88-95	48-51	40-41	42-43	44-45
				96-127	96-111	96-103	52-55	46-47	48-49	50-51
						104-111	56-59	52-53	54-55	
					112-127	112-119	60-63	56-57	58-59	60-61
						120-127	64-67	62-63	64-65	66-67
		128-255		128-191	128-159	128-143	64-71	66-67	68-69	
						136-143	68-71	70-71	72-73	
						144-151	72-75	74-75	76-77	
						152-159	76-79	78-79	80-81	
					160-191	160-175	160-167	80-83	82-83	84-85
							168-175	84-87	86-87	88-89
						176-191	176-183	88-91	90-91	92-93
							184-191	92-95	94-95	96-97
			192-255	192-223	192-207	192-199	96-99	98-99	100-101	
						200-207	100-103	102-103	104-105	
					208-223	208-215	104-107	106-107	108-109	
						216-223	108-111	110-111	112-113	
				224-255	224-239	224-231	112-115	114-115	116-117	
						232-239	116-119	118-119	120-121	
					240-255	240-247	120-123	122-123	124-125	
						248-255	124-127	126-127	128-129	

VLSM

with

Class A and B Addresses

Problem 36

Part 2 of 3

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

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

Hint:

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

Eastern Elementary School
Address Range 172.32.42.0 to 172.32.43.255

Customer Name	Number of Addresses	Address Range (Include subnet & broadcast addresses)	CIDR
Students	250	<i>172.32.42.0 to 172.32.42.255</i>	<i>/24</i>
Printers	45	<i>172.32.43.0 to 172.32.43.63</i>	<i>/26</i>
Staff	40	<i>172.32.43.64 to 172.32.43.127</i>	<i>/26</i>
Network Devices	25	<i>172.32.43.128 to 172.32.43.159</i>	<i>/27</i>
Administrative	12	<i>172.32.43.160 to 172.32.43.175</i>	<i>/28</i>

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
				16-31		8-11
						12-15
			32-63	32-47	16-19	
					20-23	
					24-27	
					28-31	
		48-63		32-35		
				36-39		
				40-43		
				44-47		
		64-127	64-79	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		
160-191			128-131			
			132-135			
			136-139			
			140-143			
192-255		144-159	144-147			
			148-151			
			152-155			
			156-159			
		224-255	160-163			
			164-167			
			168-171			
			172-175			
128-255	128-191	128-159	176-179			
			180-183			
			184-187			
			188-191			
		160-175	192-195			
			196-199			
			200-203			
			204-207			
	192-255	192-223	208-211			
			212-215			
			216-219			
			220-223			
		224-239	224-227			
			228-231			
			232-235			
			236-239			
240-255	240-255	240-243				
		244-247				
		248-251				
		252-255				
	240-255	240-247				
		244-247				
		248-251				
		252-255				

VLSM

with

Class A and B Addresses

Problem 36

Part 3 of 3

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

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

Hint:

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

South High School

Address Range 172.32.**16.0** to 172.32.**23.255**

Customer Name	Number of Addresses	Address Range (Include subnet & broadcast addresses)	CIDR
Students	1,000	172.32.16.0 to 172.32.19.255	/22
Network Devices	250	172.32.20.0 to 172.32.20.255	/24
Printers	200	172.32.21.0 to 172.32.21.255	/24
Staff	150	172.32.22.0 to 172.32.22.255	/24
Administrative	50	172.32.23.0 to 172.32.23.63	/26

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

VLSM

with

Class A and B Addresses

Problem 37

Part 1 of 3

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

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

Company Address 110.0.0.0

Customer Name	Number of Addresses	Address Range (Include subnet & broadcast addresses)	CIDR
Moskva	3,050,000	<i>110.0.0.0 to 110.63.255.255</i>	<i>/10</i>
New York	1,540,000	<i>110.64.0.0 to 110.95.255.255</i>	<i>/11</i>
St. Petersburg	1,075,000	<i>110.96.0.0 to 110.127.255.255</i>	<i>/11</i>
London	975,000	<i>110.128.0.0 to 110.143.255.255</i>	<i>/12</i>
Ekaterinoburg	525,000	<i>110.144.0.0 to 110.159.255.255</i>	<i>/12</i>
Munchen	450,000	<i>110.160.0.0 to 110.167.255.255</i>	<i>/13</i>
Napoli	150,000	<i>110.168.0.0 to 110.171.255.255</i>	<i>/14</i>
Birmingham	130,000	<i>110.172.0.0 to 110.173.255.255</i>	<i>/15</i>
Rotterdam	95,000	<i>110.174.0.0 to 110.175.255.255</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			
				16-31	8-15	4-7	4-5			
				32-63	16-23	8-11	6-7	8-9		
					24-31	12-15	10-11	12-13		
					32-47	16-19	12-15	14-15	16-17	
						20-23	16-19	18-19	20-21	
						24-27	20-23	22-23	24-25	
						28-31	24-27	26-27	28-29	
						32-35	28-31	30-31	32-33	
					48-63	36-39	32-35	34-35	36-37	
			40-43			36-39	38-39	40-41		
			44-47			40-43	42-43	44-45		
			48-51	44-47		46-47	48-49			
			52-55	48-51		50-51	52-53			
			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	72-73	70-71	72-73
							76-79	74-75	74-75	76-77
							80-83	76-77	78-79	80-81
					84-87		80-83	82-83	84-85	
					88-91		84-85	86-87	88-89	
					96-111	88-95	88-91	90-91	92-93	
						96-103	92-95	92-93	94-95	96-97
							96-99	96-97	98-99	100-101
				100-103			98-99	100-103	102-103	
		104-107		100-101			104-105	106-107		
		108-111		102-103			108-109	110-111		
		112-127		104-111		104-107	110-111	112-113		
				112-119		108-111	112-113	114-115		
				116-119		112-115	112-115	116-117	118-119	
						120-123	116-119	120-121	122-123	
				120-127	124-127	124-125	126-127			
		128-255		128-191	128-159	128-143	128-135	128-131	128-129	
						136-143	132-135	130-131	132-133	
						144-151	136-139	134-135	136-137	
						148-151	140-143	138-139	140-141	
						152-159	142-143	142-143	144-145	
					160-191	152-155	144-147	146-147	148-149	
						156-159	148-151	148-149	150-151	
			160-167			152-155	152-153	154-155		
			164-167			156-157	156-157	158-159		
			168-171			160-167	160-163	162-163		
			176-191		166-167	164-167	164-165	166-167		
					172-175	168-171	168-169	170-171		
					176-177	172-175	172-173	174-175		
					176-179	176-177	176-177	178-179		
					180-183	176-179	180-181	182-183		
			192-255	192-223	192-219	184-191	176-183	180-183	182-183	
						188-191	184-187	184-185	186-187	
						192-195	188-191	188-189	190-191	
	196-199					192-195	192-193	194-195		
	200-203					196-199	196-197	198-199		
	208-223			200-207	200-203	200-201	202-203			
				204-207	204-207	202-203	204-205			
				208-215	208-211	206-207	208-209			
				216-223	212-215	208-211	210-211	212-213		
					216-219	212-215	212-213	214-215		
	220-223	216-217	216-217	218-219						
	224-255	224-239	224-231	224-231	224-227	224-221	224-225			
				228-231	228-231	226-227	228-229			
				232-235	232-235	230-231	232-233			
				236-239	236-239	232-233	234-235			
				240-243	236-239	236-237	238-239			
		240-255	240-247	240-243	240-241	242-243				
			244-247	244-247	242-243	244-245				
			248-251	248-251	246-247	248-249				
			252-255	252-255	250-251	252-253				
			252-255	252-255	252-253	254-255				

VLSM

with

Class A and B Addresses

Problem 37

Part 2 of 3

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

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

London
Address Range 110.128.0.0 to 110.143.255.255

Customer Name	Number of Addresses	Address Range (Include subnet & broadcast addresses)	CIDR
Office #1	6,450	<i>110.128.0.0 to 110.128.31.255</i>	<i>/19</i>
Office #2	3,780	<i>110.128.32.0 to 110.128.47.255</i>	<i>/19</i>
Office #3	2,750	<i>110.128.48.0 to 110.128.63.255</i>	<i>/19</i>
Office #4	2,000	<i>110.128.064.0 to 110.128.71.255</i>	<i>/21</i>
Office #5	1,000	<i>110.128.72.0 to 110.128.75.255</i>	<i>/21</i>
Office #6	845	<i>110.128.76.0 to 110.128.79.255</i>	<i>/21</i>
Office #7	500	<i>110.128.80.0 to 110.128.81.255</i>	<i>/22</i>
Office #8	450	<i>110.128.82.0 to 110.128.83.255</i>	<i>/22</i>
Office #9	300	<i>110.128.84.0 to 110.128.85.255</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	
					32-63	32-47	16-19	8-9
							20-23	10-11
			24-27				12-13	
			48-63			28-31	14-15	
				32-35		16-17		
				36-39		18-19		
			64-127	64-95	64-79	30-31	20-21	
						40-47	22-23	
		44-47				24-25		
		80-95			48-51	26-27		
					52-55	28-29		
		96-127		96-111	56-57	30-31		
					60-63	32-33		
					64-67	34-35		
				112-127	68-71	36-37		
					72-79	38-39		
		128-255	128-191	128-159	40-41	42-43		
					44-45	44-45		
					144-159	46-47	46-47	
						48-49	48-49	
						50-51	50-51	
					160-191	160-175	52-53	52-53
	54-55			54-55				
	56-57			56-57				
	176-191			58-59		58-59		
				60-61		60-61		
				62-63		62-63		
	192-255			192-223	192-207	64-65	64-65	
			66-67			66-67		
			68-69			68-69		
			70-71			70-71		
			208-223		72-73	72-73		
					74-75	74-75		
					76-77	76-77		
			224-255	224-239	78-79	78-79		
					80-83	80-83		
					84-87	84-87		
				240-255	88-91	88-91		
					92-95	92-95		
					96-97	96-97		
					98-99	98-99		

VLSM

with

Class A and B Addresses

Problem 37

Part 3 of 3

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

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

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

Customer Name	Number of Addresses	Address Range	CIDR
1st Floor	125	<i>110.128.80.0 to 110.128.80.127</i>	<i>/25</i>
2nd Floor	75	<i>110.128.80.128 to 110.128.80.255</i>	<i>/25</i>
5th Floor	50	<i>110.128.81.0 to 110.128.81.63</i>	<i>/26</i>
8th Floor	45	<i>110.128.81.64 to 110.128.81.127</i>	<i>/26</i>
4th Floor	30	<i>110.128.81.128 to 110.128.81.159</i>	<i>/27</i>
Basement	14	<i>110.128.81.160 to 110.128.81.175</i>	<i>/28</i>
7th Floor	12	<i>110.128.81.176 to 110.128.81.191</i>	<i>/28</i>
3rd Floor	6	<i>110.128.81.192 to 110.128.81.199</i>	<i>/29</i>
6th Floor	4	<i>110.128.81.200 to 110.128.81.207</i>	<i>/29</i>

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

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	<i>75.0.0.0 to 75.127.255.255</i>	<i>/9</i>
China	4 million	<i>75.128.0.0 to 75.191.255.255</i>	<i>/10</i>
Japan	1 million	<i>75.192.0.0 to 75.207.255.255</i>	<i>/12</i>
Germany	500,000	<i>75.208.0.0 to 75.215.255.255</i>	<i>/13</i>
Russia	455,000	<i>75.216.0.0 to 75.223.255.255</i>	<i>/13</i>
Australia	450,000	<i>75.224.0.0 to 75.231.255.255</i>	<i>/13</i>
Brazil	125,000	<i>75.232.0.0 to 75.233.255.255</i>	<i>/15</i>
Canda	90,000	<i>75.234.0.0 to 75.235.255.255</i>	<i>/15</i>
Denmark	88,000	<i>75.236.0.0 to 75.237.255.255</i>	<i>/15</i>

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	8-11	4-5	2-3		
				16-31	16-23	16-19	6-7	4-5	
					24-31	20-23	8-9	6-7	
					32-47	32-39	24-27	10-11	8-9
						40-47	28-31	12-13	10-11
			48-63			48-55	32-35	14-15	12-13
						56-63	36-39	16-17	14-15
				64-95		64-71	40-43	18-19	16-17
						80-87	44-47	20-21	18-19
					96-111	88-95	48-49	22-23	20-21
						96-103	50-51	24-25	22-23
		112-127	96-111			52-53	26-27	24-25	
			104-111			54-55	28-29	26-27	
			128-159	112-119		56-57	30-31	28-29	
				120-127		58-59	32-33	30-31	
				160-191	128-135	60-61	34-35	32-33	
					136-143	62-63	36-37	34-35	
		176-191			144-151	64-65	38-39	36-37	
					184-191	66-67	40-41	38-39	
			192-207		160-167	68-69	42-43	40-41	
					176-179	70-71	44-45	42-43	
				192-223	160-175	72-73	46-47	44-45	
					200-207	74-75	48-49	46-47	
	208-223	176-183			76-77	50-51	48-49		
		216-219			78-79	52-53	50-51		
		224-239	184-191		80-81	54-55	52-53		
			232-239		82-83	56-57	54-55		
			240-255	192-199	84-85	58-59	56-57		
				240-247	86-87	60-61	58-59		
	248-255			200-207	88-89	62-63	60-61		
				248-251	90-91	64-65	62-63		
		252-255		208-215	92-93	66-67	64-65		
				252-255	94-95	68-69	66-67		
			252-255	216-223	96-97	70-71	68-69		
				224-227	98-99	72-73	70-71		
	232-239			224-231	100-103	74-75	72-73		
				232-235	102-103	76-77	74-75		
		240-247		232-239	104-105	78-79	76-77		
				240-243	106-107	80-81	78-79		
			248-251	240-247	108-111	82-83	80-81		
				248-251	110-111	84-85	82-83		
	252-255			248-251	112-113	86-87	84-85		
				252-255	114-115	88-89	86-87		
		252-255		252-255	116-119	90-91	88-89		
				252-255	118-119	92-93	90-91		
			252-255	252-255	120-121	94-95	92-93		
				252-255	122-123	96-97	94-95		
252-255	252-255			124-127	98-99	96-97			
	252-255			126-127	100-101	98-99			
	252-255	252-255		128-129	102-103	100-101			
		252-255		130-131	104-105	102-103			
		252-255	252-255	132-133	106-107	104-105			
			252-255	134-135	108-109	106-107			
252-255			252-255	136-139	110-111	108-109			
			252-255	140-141	112-113	110-111			
	252-255		252-255	142-143	114-115	112-113			
			252-255	144-145	116-117	114-115			
		252-255	252-255	146-147	118-119	116-117			
			252-255	148-151	120-121	118-119			
252-255			252-255	150-153	122-123	120-121			
			252-255	152-153	124-127	122-123			
	252-255		252-255	154-155	126-127	124-125			
			252-255	156-157	128-129	126-127			
		252-255	252-255	158-159	130-131	128-129			
			252-255	160-161	132-133	130-131			
252-255			252-255	162-163	134-135	132-133			
			252-255	164-165	136-137	134-135			
	252-255		252-255	166-167	138-139	136-137			
			252-255	168-169	140-141	138-139			
		252-255	252-255	170-171	142-143	140-141			
			252-255	172-173	144-145	142-143			
252-255			252-255	174-175	146-147	144-145			
			252-255	176-177	148-149	146-147			
	252-255		252-255	178-179	150-151	148-149			
			252-255	180-181	152-153	150-151			
		252-255	252-255	182-183	154-155	152-153			
			252-255	184-185	156-157	154-155			
252-255			252-255	186-187	158-159	156-157			
			252-255	188-189	160-161	158-159			
	252-255		252-255	190-191	162-163	160-161			
			252-255	192-193	164-165	162-163			
		252-255	252-255	194-195	166-167	164-165			
			252-255	196-199	168-169	166-167			
252-255			252-255	200-203	170-171	168-169			
			252-255	204-207	172-173	170-171			
	252-255		252-255	208-211	174-175	172-173			
			252-255	212-213	176-177	174-175			
		252-255	252-255	216-217	178-179	176-177			
			252-255	218-219	180-181	178-179			
252-255			252-255	220-221	182-183	180-181			
			252-255	222-223	184-185	182-183			
	252-255		252-255	224-227	186-187	184-185			
			252-255	228-231	188-189	186-187			
		252-255	252-255	232-233	190-191	188-189			
			252-255	234-235	192-193	190-191			
252-255			252-255	236-239	194-195	192-193			
			252-255	240-243	196-197	194-195			
	252-255		252-255	244-247	198-199	196-197			
			252-255	248-249	200-201	198-199			
		252-255	252-255	252-253	202-203	200-201			
			252-255	254-255	204-205	202-203			
252-255			252-255	252-255	206-207	204-205			
			252-255	252-255	208-209	206-207			
	252-255		252-255	252-255	210-211	208-209			
			252-255	252-255	212-213	210-211			
		252-255	252-255	252-255	214-215	212-213			
			252-255	252-255	216-217	214-215			
252-255			252-255	252-255	218-219	216-217			
			252-255	252-255	220-221	218-219			
	252-255		252-255	252-255	222-223	220-221			
			252-255	252-255	224-227	222-223			
		252-255	252-255	252-255	226-227	224-225			
			252-255	252-255	228-229	226-227			
252-255			252-255	252-255	230-231	228-229			
			252-255	252-255	232-233	230-231			
	252-255		252-255	252-255	234-235	232-233			
			252-255	252-255	236-239	234-235			
		252-255	252-255	252-255	240-243	236-235			
			252-255	252-255	242-243	238-239			
252-255			252-255	252-255	244-245	240-241			
			252-255	252-255	246-247	242-243			
	252-255		252-255	252-255	248-249	244-245			
			252-255	252-255	250-251	246-247			
		252-255	252-255	252-255	252-253	248-249			
			252-255	252-255	254-255	250-251			
252-255			252-255	252-255	252-253	252-253			
			252-255	252-255	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	<i>75.0.0.0 to 75.31.255.255</i>	<i>/11</i>
Client #2	1,000,000	<i>75.32.0.0 to 75.47.255.255</i>	<i>/12</i>
Client #3	950,000	<i>75.48.0.0 to 75.63.255.255</i>	<i>/12</i>
Client #4	700,000	<i>75.64.0.0 to 75.79.255.255</i>	<i>/12</i>
Client #5	550,000	<i>75.80.0.0 to 75.95.255.255</i>	<i>/12</i>
Client #6	500,000	<i>75.96.0.0 to 75.103.255.255</i>	<i>/13</i>
Client #7	450,000	<i>75.104.0.0 to 75.111.255.255</i>	<i>/13</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 4-7	0-1 2-3 4-5 6-7 8-9 10-11 12-13 14-15		
				16-31	8-15	8-11 12-15	16-17 18-19 20-21 22-23 24-25 26-27 28-29 30-31 32-33 34-35		
					32-63	32-39	32-35 36-39	36-37 38-39 40-41 42-43 44-45 46-47 48-49 50-51 52-53 54-55 56-57 58-59	
						48-63	48-55 56-63	60-61 62-63 64-65 66-67 68-69 70-71 72-73 74-75 76-77 78-79	
				64-127		64-95	64-71	64-67 68-71	80-81 82-83 84-85 86-87 88-89 90-91 92-93 94-95 96-97 98-99
					80-95		80-87 88-95	100-101 102-103 104-105 106-107 108-109 110-111 112-113 114-115 116-117 118-119	
			96-111		96-103 104-111		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		
			96-127		128-143	128-135 136-143	160-161 162-163 164-165 166-167 168-169 170-171 172-173 174-175 176-177 178-179		
					144-159	144-151 152-159	180-181 182-183 184-185 186-187 188-189 190-191 192-193 194-195 196-197 198-199		
					160-191	160-167 168-175	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		
			128-255	128-191	128-159	176-191	176-183 184-191	240-241 242-243 244-245 246-247 248-249 250-251 252-253 254-255	
						160-191	192-199	192-195 196-199	
							192-207	200-207 204-207	
					192-223		208-215	208-211 212-215	
							208-223	216-219	216-219 220-223
		224-231						224-227 228-231	
		192-255			224-239		232-239	232-235 236-239	
						224-255	240-247	240-243 244-247	
							240-255	248-251 248-255	

VLSM

with

Class A and B Addresses

Sample Problem 38

Part 3 of 4

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

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

ISP Addresses 75.104.0.0 to 75.111.255.255

Customer Name	Number of Addresses	Address Range	CIDR
Office #1	60,000	<i>75.104.0.0 to 75.104.255.255</i>	<i>/16</i>
Office #2	45,000	<i>75.105.0.0 to 75.105.255.255</i>	<i>/16</i>
Office #3	30,000	<i>75.106.0.0 to 75.106.127.255</i>	<i>/17</i>
Office #4	24,000	<i>75.106.128.0 to 75.106.255.255</i>	<i>/17</i>
Office #5	15,000	<i>75.107.0.0 to 75.107.63.255</i>	<i>/18</i>
Office #6	10,000	<i>75.107.64.0 to 75.107.127.255</i>	<i>/18</i>
Office #7	8,000	<i>75.107.128.0 to 75.107.159.255</i>	<i>/19</i>
Office #8	2,000	<i>75.107.160.0 to 75.107.167.255</i>	<i>/21</i>
Office #9	1,000	<i>75.107.168.0 to 75.107.171.255</i>	<i>/22</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		
				16-31	8-15	4-7	2-3		
				32-63	16-23	8-11	4-5	4-5	
					24-31	12-15	6-7	6-7	
			64-127	64-95	64-79	32-39	16-19	12-15	12-13
						40-47	20-23	14-15	14-15
					80-95	48-55	24-27	16-17	16-17
						56-63	28-31	18-19	18-19
		96-127		96-111	64-71	32-35	20-21	20-21	
					72-79	36-39	22-23	22-23	
				112-127	80-87	40-43	24-25	24-25	
					88-95	44-47	26-27	26-27	
		128-255	128-191	128-159	128-143	48-51	28-29	28-29	
					136-143	52-55	30-31	30-31	
					144-159	56-59	32-33	32-33	
						152-159	34-35	34-35	
	160-191			160-167	36-37	36-37			
				168-175	38-39	38-39			
				176-191	172-175	40-41	40-41		
					184-191	42-43	42-43		
	192-255		192-223	192-199	176-183	44-45	44-45		
					184-191	46-47	46-47		
				200-207	192-199	48-49	48-49		
					200-207	50-51	50-51		
			208-223	208-215	208-215	52-53	52-53		
					216-223	54-55	54-55		
				216-223	216-219	56-57	56-57		
					224-231	58-59	58-59		
	224-255	224-239	224-231	60-61	60-61				
			232-239	62-63	62-63				
		240-247	240-243	64-65	64-65				
			248-255	66-67	66-67				
			68-69	68-69					
			70-71	70-71					
			72-73	72-73					
			74-75	74-75					
			76-77	76-77					
			78-79	78-79					
			80-81	80-81					
			82-83	82-83					
			84-85	84-85					
			86-87	86-87					
			88-89	88-89					
			90-91	90-91					
			92-93	92-93					
			94-95	94-95					
			96-97	96-97					
			98-99	98-99					
			100-101	100-101					
			102-103	102-103					
			104-105	104-105					
			106-107	106-107					
			108-109	108-109					
			110-111	110-111					
			112-113	112-113					
			114-115	114-115					
			116-117	116-117					
			118-119	118-119					
			120-121	120-121					
			122-123	122-123					
			124-125	124-125					
			126-127	126-127					
			128-129	128-129					
			130-131	130-131					
			132-133	132-133					
			134-135	134-135					
			136-137	136-137					
			138-139	138-139					
			140-141	140-141					
			142-143	142-143					
			144-145	144-145					
			146-147	146-147					
			148-149	148-149					
			150-151	150-151					
			152-153	152-153					
			154-155	154-155					
			156-157	156-157					
			158-159	158-159					
			160-161	160-161					
			162-163	162-163					
			164-165	164-165					
			166-167	166-167					
			168-169	168-169					
			170-171	170-171					
			172-173	172-173					
			174-175	174-175					
			176-177	176-177					
			178-179	178-179					
			180-181	180-181					
			182-183	182-183					
			184-185	184-185					
			186-187	186-187					
			188-189	188-189					
			190-191	190-191					
			192-193	192-193					
			194-195	194-195					
			196-197	196-197					
			198-199	198-199					
			200-201	200-201					
			202-203	202-203					
			204-205	204-205					
			206-207	206-207					
			208-209	208-209					
			210-211	210-211					
			212-213	212-213					
			214-215	214-215					
			216-217	216-217					
			218-219	218-219					
			220-221	220-221					
			222-223	222-223					
			224-225	224-225					
			226-227	226-227					
			228-229	228-229					
			230-231	230-231					
			232-233	232-233					
			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 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	<i>75.107.128.0 to 75.107.143.255</i>	<i>/20</i>
Branch #2	2,000	<i>75.107.144.0 to 75.107.151.255</i>	<i>/21</i>
Branch #3	1,000	<i>75.107.152.0 to 75.107.155.255</i>	<i>/22</i>
Branch #4	500	<i>75.107.156.0 to 75.107.159.255</i>	<i>/23</i>
Branch #5	450	<i>75.107.160.0 to 75.107.161.255</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	32-39	16-19	8-9
						40-47	20-23	10-11
			48-63			48-55	24-27	12-13
						56-63	28-31	14-15
				64-95		64-71	30-31	16-17
						80-87	32-35	18-19
					96-111	96-103	36-39	20-21
						104-111	40-43	22-23
		112-127	112-119			44-47	24-25	
			120-127			48-51	26-27	
			128-191	128-135		52-55	28-29	
				136-143		56-59	30-31	
				144-159	144-147	60-63	32-33	
					152-159	64-67	34-35	
		160-175			160-167	68-69	36-37	
					168-175	70-71	38-39	
			176-191		176-183	72-73	40-41	
					184-191	74-75	42-43	
				192-207	192-199	76-77	44-45	
					200-207	78-79	46-47	
	192-223	192-199			80-81	48-49		
		200-207			82-83	50-51		
		208-223	208-215		84-85	52-53		
			216-223		86-87	54-55		
			224-239	224-231	88-89	56-57		
				232-239	90-91	58-59		
	240-255			240-247	92-95	60-61		
				248-255	96-97	62-63		
		240-255		240-247	98-99	64-65		
				248-255	100-103	66-67		
			240-255	240-247	104-107	68-69		
				248-255	108-111	70-71		
	240-255			240-247	112-115	72-73		
				248-255	116-119	74-75		
		240-255		240-247	120-123	76-77		
				248-255	124-127	78-79		
			240-255	240-247	128-131	80-81		
				248-255	132-135	82-83		
	240-255			240-247	136-139	84-85		
				248-255	140-143	86-87		
		240-255		240-247	144-147	88-89		
				248-255	148-151	90-91		
			240-255	240-247	152-155	92-93		
				248-255	156-159	94-95		
	240-255			240-247	160-163	96-97		
				248-255	164-167	98-99		
		240-255		240-247	168-171	100-101		
				248-255	172-175	102-103		
240-255			240-247	176-179	104-105			
			248-255	180-183	106-107			
	240-255		240-247	184-187	108-109			
			248-255	188-191	110-111			
		240-255	240-247	192-195	112-113			
			248-255	196-199	114-115			
240-255			240-247	200-203	116-117			
			248-255	204-207	118-119			
	240-255		240-247	208-211	120-121			
			248-255	212-215	122-123			
		240-255	240-247	216-219	124-125			
			248-255	220-223	126-127			
240-255			240-247	224-227	128-129			
			248-255	228-231	130-131			
	240-255		240-247	232-235	132-133			
			248-255	236-239	134-135			
		240-255	240-247	240-243	136-137			
			248-255	244-247	138-139			
240-255			240-247	248-251	140-141			
			248-255	252-255	142-143			
	240-255		240-247	248-251	144-145			
			248-255	252-255	146-147			
		240-255	240-247	248-251	148-149			
			248-255	252-255	150-151			
240-255			240-247	248-251	152-153			
			248-255	252-255	154-155			
	240-255		240-247	248-251	156-157			
			248-255	252-255	158-159			
		240-255	240-247	248-251	160-161			
			248-255	252-255	162-163			
240-255			240-247	248-251	164-165			
			248-255	252-255	166-167			
	240-255		240-247	248-251	168-169			
			248-255	252-255	170-171			
		240-255	240-247	248-251	172-173			
			248-255	252-255	174-175			
240-255			240-247	248-251	176-177			
			248-255	252-255	178-179			
	240-255		240-247	248-251	180-181			
			248-255	252-255	182-183			
		240-255	240-247	248-251	184-185			
			248-255	252-255	186-187			
240-255			240-247	248-251	188-189			
			248-255	252-255	190-191			
	240-255		240-247	248-251	192-193			
			248-255	252-255	194-195			
		240-255	240-247	248-251	196-197			
			248-255	252-255	198-199			
240-255			240-247	248-251	200-201			
			248-255	252-255	202-203			
	240-255		240-247	248-251	204-205			
			248-255	252-255	206-207			
		240-255	240-247	248-251	208-209			
			248-255	252-255	210-211			
240-255			240-247	248-251	212-213			
			248-255	252-255	214-215			
	240-255		240-247	248-251	216-217			
			248-255	252-255	218-219			
		240-255	240-247	248-251	220-221			
			248-255	252-255	222-223			
240-255			240-247	248-251	224-225			
			248-255	252-255	226-227			
	240-255		240-247	248-251	228-229			
			248-255	252-255	230-231			
		240-255	240-247	248-251	232-233			
			248-255	252-255	234-235			
240-255			240-247	248-251	236-237			
			248-255	252-255	238-239			
	240-255		240-247	248-251	240-241			
			248-255	252-255	242-243			
		240-255	240-247	248-251	244-245			
			248-255	252-255	246-247			
240-255			240-247	248-251	248-249			
			248-255	252-255	250-251			
	240-255		240-247	248-251	252-253			
			248-255	252-255	254-255			

Reference Charts and Support Materials

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

10	11	12	13	14	15	
208.208.0.0 8,192 Hosts	208.208.64.0 4,096 Hosts	208.208.128.0 2,048 Hosts	208.208.192.0 1,024 Hosts	208.208.256.0 512 Hosts	208.208.320.0 256 Hosts	
0-127	0-8	0-15	8-15	0-7	8-15	
		16-31	16-31	16-31	16-31	
		32-63	32-63	32-63	32-63	
		64-127	64-127	64-127	64-127	
	64-127	64-79	80-95	80-95	80-95	80-95
			96-111	96-111	96-111	96-111
		112-127	112-119	112-119	112-119	112-119
			120-127	120-127	120-127	120-127
	128-255	128-143	128-143	128-143	128-143	128-143
			144-159	144-159	144-159	144-159
			160-175	160-175	160-175	160-175
			176-191	176-191	176-191	176-191
		192-255	192-207	192-207	192-207	192-207
			208-223	208-223	208-223	208-223
			224-239	224-239	224-239	224-239
			240-255	240-255	240-255	240-255

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

16	17	18	19	20	21	22	23	
208.209.0.0 65,536 Hosts	208.209.128.0 32,768 Hosts	208.209.256.0 16,384 Hosts	208.209.384.0 8,192 Hosts	208.209.512.0 4,096 Hosts	208.209.640.0 2,048 Hosts	208.209.768.0 1,024 Hosts	208.209.896.0 512 Hosts	
0-127	0-8	0-15	8-15	0-7	8-15	0-7	8-15	
		16-31	16-31	16-31	16-31	16-31	16-31	
		32-63	32-63	32-63	32-63	32-63	32-63	
		64-127	64-127	64-127	64-127	64-127	64-127	
	64-127	64-79	80-95	80-95	80-95	80-95	80-95	80-95
			96-111	96-111	96-111	96-111	96-111	96-111
		112-127	112-119	112-119	112-119	112-119	112-119	112-119
			120-127	120-127	120-127	120-127	120-127	120-127
	128-255	128-143	128-143	128-143	128-143	128-143	128-143	128-143
			144-159	144-159	144-159	144-159	144-159	144-159
			160-175	160-175	160-175	160-175	160-175	160-175
			176-191	176-191	176-191	176-191	176-191	176-191
		192-255	192-207	192-207	192-207	192-207	192-207	192-207
			208-223	208-223	208-223	208-223	208-223	208-223
			224-239	224-239	224-239	224-239	224-239	224-239
			240-255	240-255	240-255	240-255	240-255	240-255

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

24	25	26	27	28	29	30	
208.210.0.0 2,048 Hosts	208.210.64.0 1,024 Hosts	208.210.128.0 512 Hosts	208.210.192.0 256 Hosts	208.210.256.0 128 Hosts	208.210.320.0 64 Hosts	208.210.384.0 32 Hosts	
0-127	0-8	0-15	8-15	0-7	8-15	0-7	
		16-31	16-31	16-31	16-31	16-31	
		32-63	32-63	32-63	32-63	32-63	
		64-127	64-127	64-127	64-127	64-127	
	64-127	64-79	80-95	80-95	80-95	80-95	80-95
			96-111	96-111	96-111	96-111	96-111
		112-127	112-119	112-119	112-119	112-119	112-119
			120-127	120-127	120-127	120-127	120-127
	128-255	128-143	128-143	128-143	128-143	128-143	128-143
			144-159	144-159	144-159	144-159	144-159
			160-175	160-175	160-175	160-175	160-175
			176-191	176-191	176-191	176-191	176-191
		192-255	192-207	192-207	192-207	192-207	192-207
			208-223	208-223	208-223	208-223	208-223
			224-239	224-239	224-239	224-239	224-239
			240-255	240-255	240-255	240-255	240-255

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	4-5	2-3		
				16-31	8-11	6-7	8-9		
				24-31	12-15	10-11	12-13		
				32-63	16-19	18-19	16-17		
					20-23	20-21	18-19		
					24-27	22-23	16-17		
			28-31		24-25	14-15			
			32-39		26-27	14-15			
			40-47		28-31	12-13			
			48-55		30-31	10-11			
			64-127	64-95	64-79	64-71	64-67	64-65	62-63
						72-79	68-71	66-67	64-65
						80-87	72-75	68-69	66-67
		80-95			76-79	76-79	74-75		
					88-95	80-83	78-79		
					84-87	84-85	80-81		
					88-91	86-87	82-83		
		96-127		96-111	96-103	96-99	94-95	92-93	
					104-111	100-103	96-97	94-95	
					112-119	104-107	98-99	96-97	
				112-127	120-123	108-111	106-107		
					124-127	112-115	108-109		
					128-135	116-117	110-111		
					136-143	118-119	112-113		
		128-255	128-191	128-159	128-143	128-131	128-129	126-127	
					136-143	132-135	128-129	126-127	
					144-151	136-139	130-131	128-129	
	152-159				140-143	132-133	130-131		
	160-191				160-175	144-147	144-145		
					168-175	148-151	146-147		
					176-183	152-155	148-149		
				184-191	156-159	150-151			
				192-207	160-167	160-163	152-153		
					168-175	164-167	154-155		
					176-183	168-171	156-157		
	184-191				172-175	158-159			
	192-255			192-223	192-207	192-199	160-167	160-161	162-163
						200-207	164-167	164-165	162-163
			208-215			168-171	166-167	164-165	
			208-223		216-217	172-175	168-169		
					224-231	176-179	170-171		
					232-239	180-183	172-173		
					240-247	184-187	174-175		
			224-255	224-239	192-199	176-177	176-177	178-179	
					200-207	180-181	180-181	180-181	
					208-215	184-185	182-183	184-185	
				240-255	216-217	188-191	186-187		
					224-231	192-195	188-189		
					232-239	196-199	190-191		
					240-247	200-203	192-193		
	248-255		240-247	204-207	204-207	194-195	196-197		
212-215				208-211	198-199	198-199			
220-223		212-215		200-201	200-201				
228-231		216-217		202-203	202-203				
248-255		236-239	220-223	204-205					
		244-247	224-227	206-207					
		252-255	228-231	208-209					
		252-255	232-235	210-211					

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

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	160-163			
			164-167			
		168-175	168-171			
			172-175			
	176-191	176-191	176-183	176-179		
				180-183		
			184-191	184-187		
				188-191		
192-255		192-207	192-199	192-195		
				196-199		
			200-207	200-203		
				204-207		
	192-223	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			

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