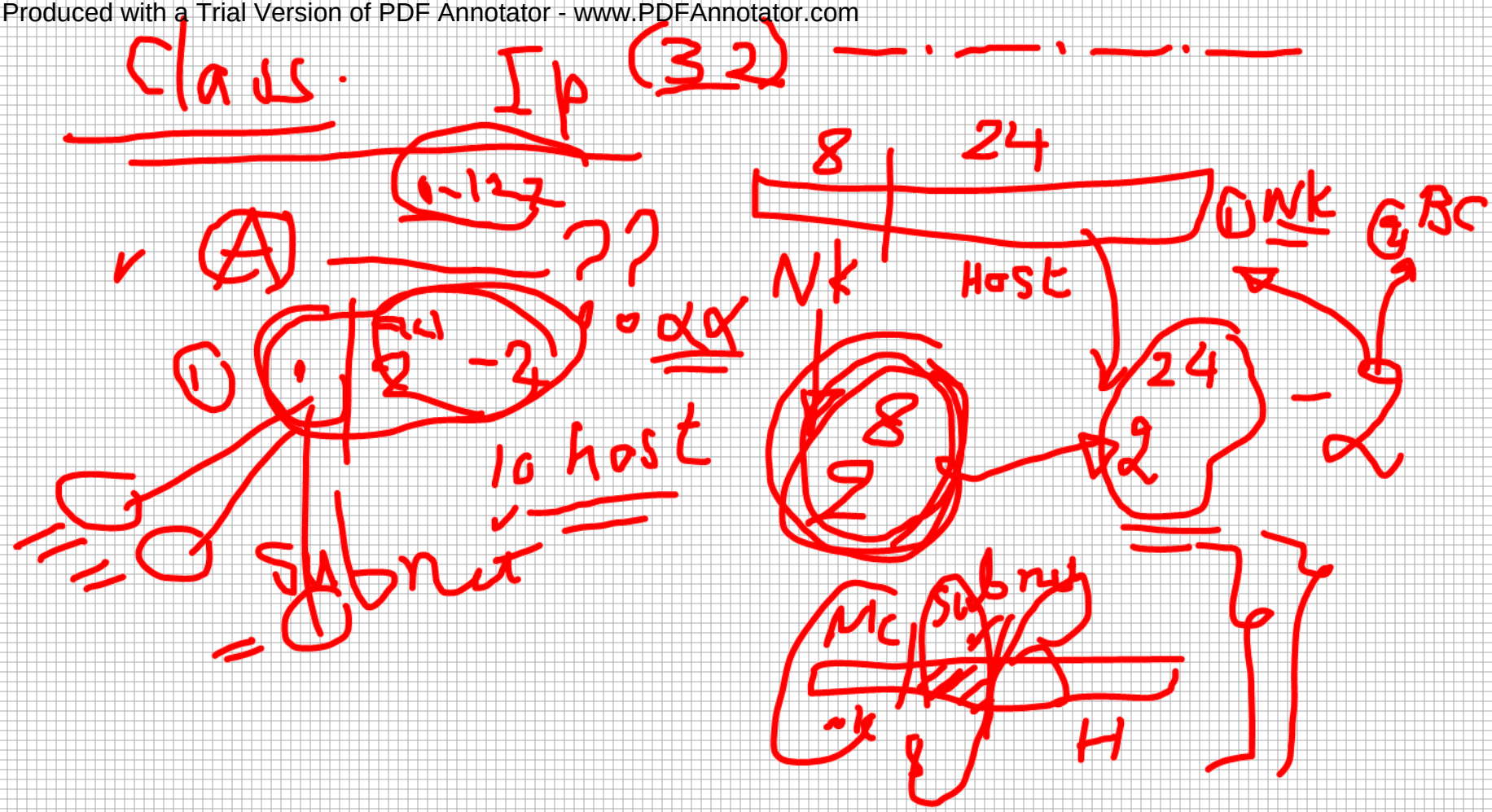
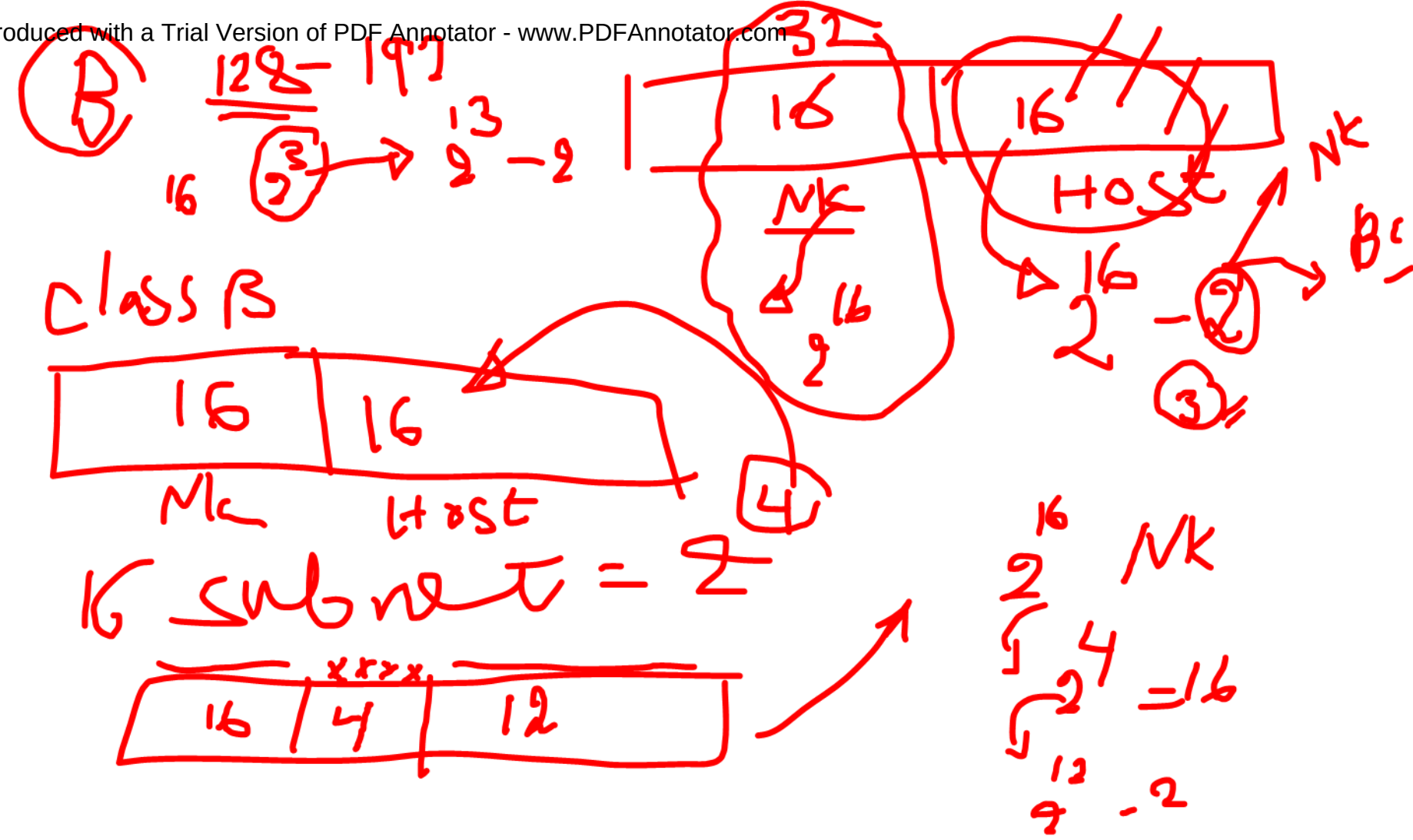
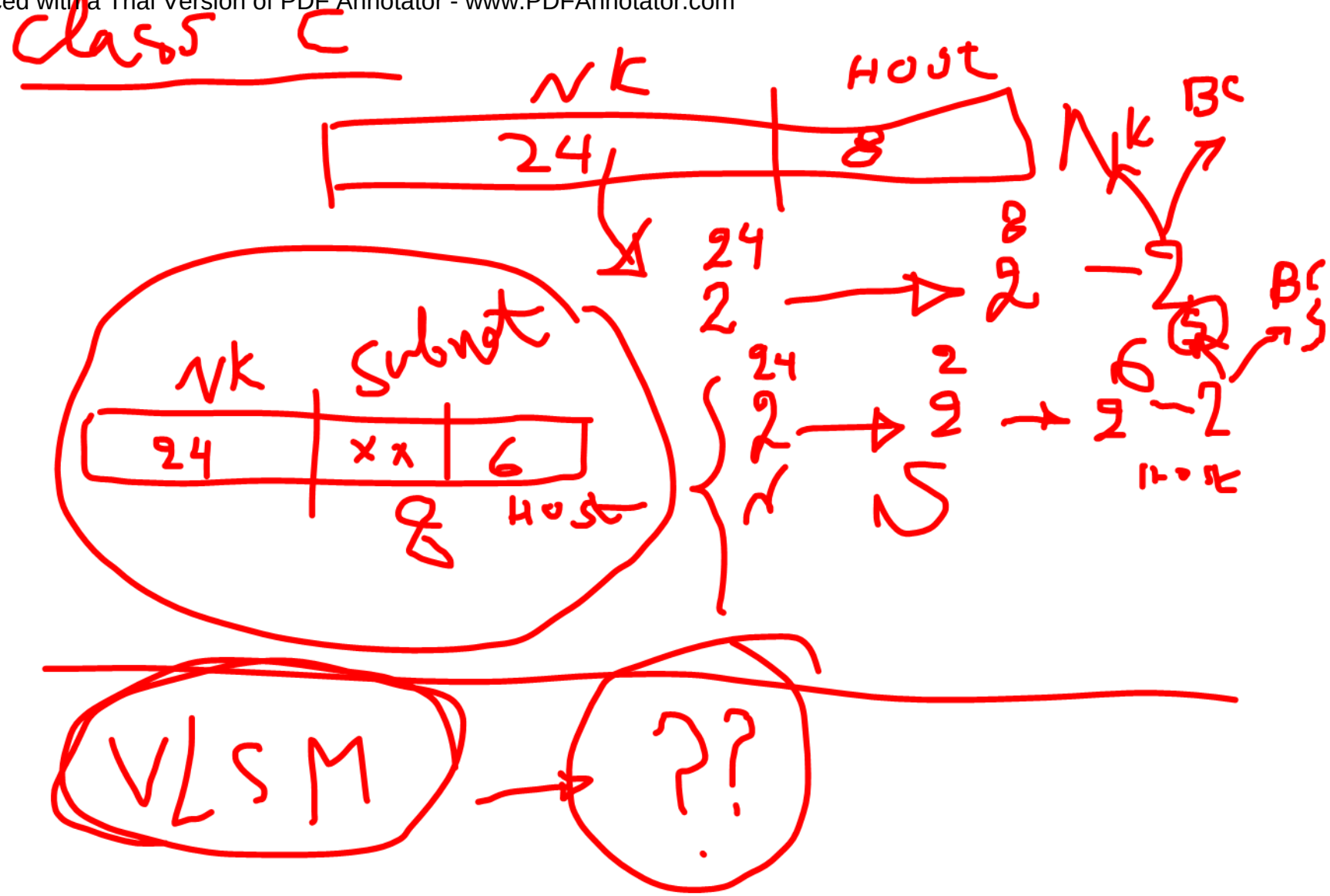
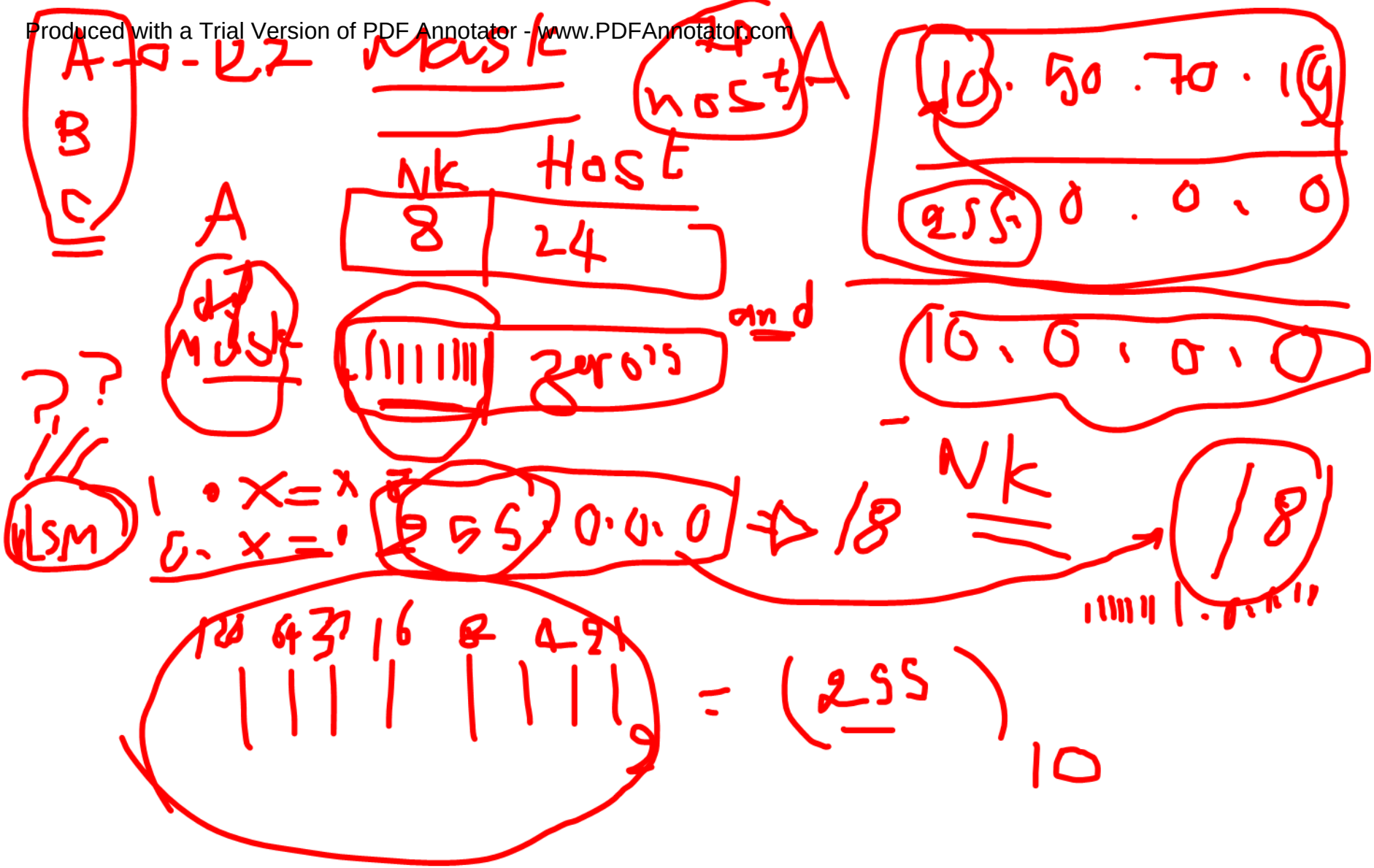
Sybex CCNA 640-803
Chapter 3: Subnetting, VLSM and Troubleshooting

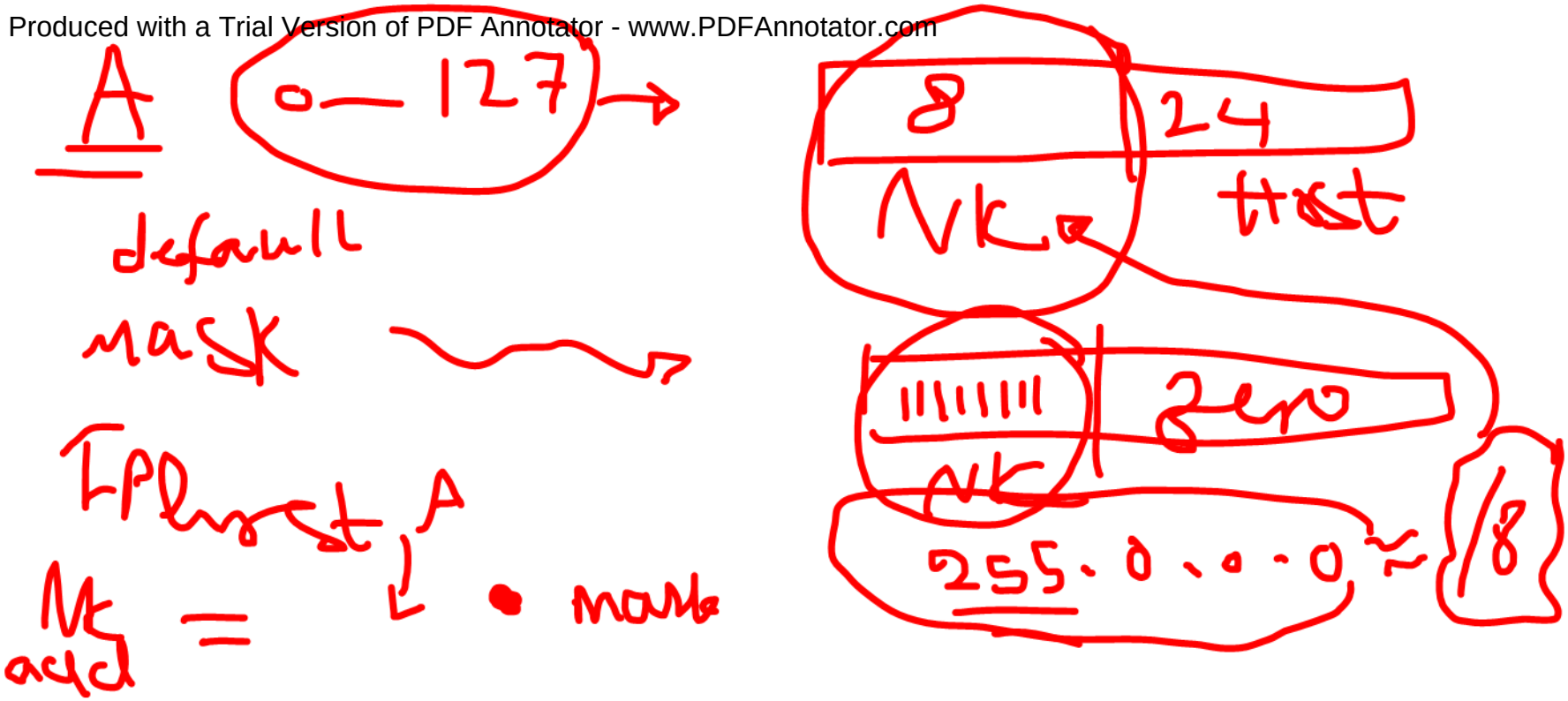
Instructor & Todd Lammle

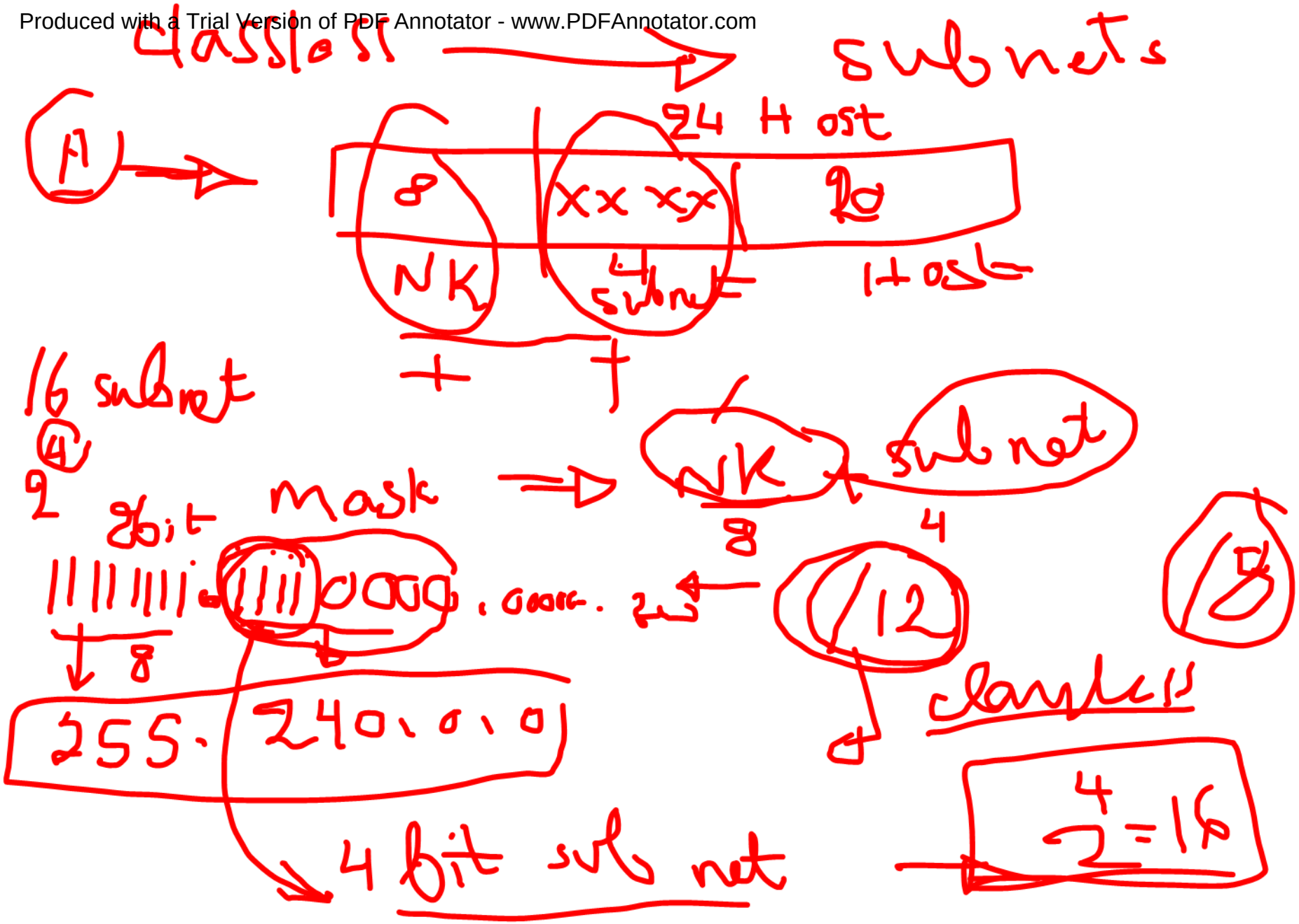




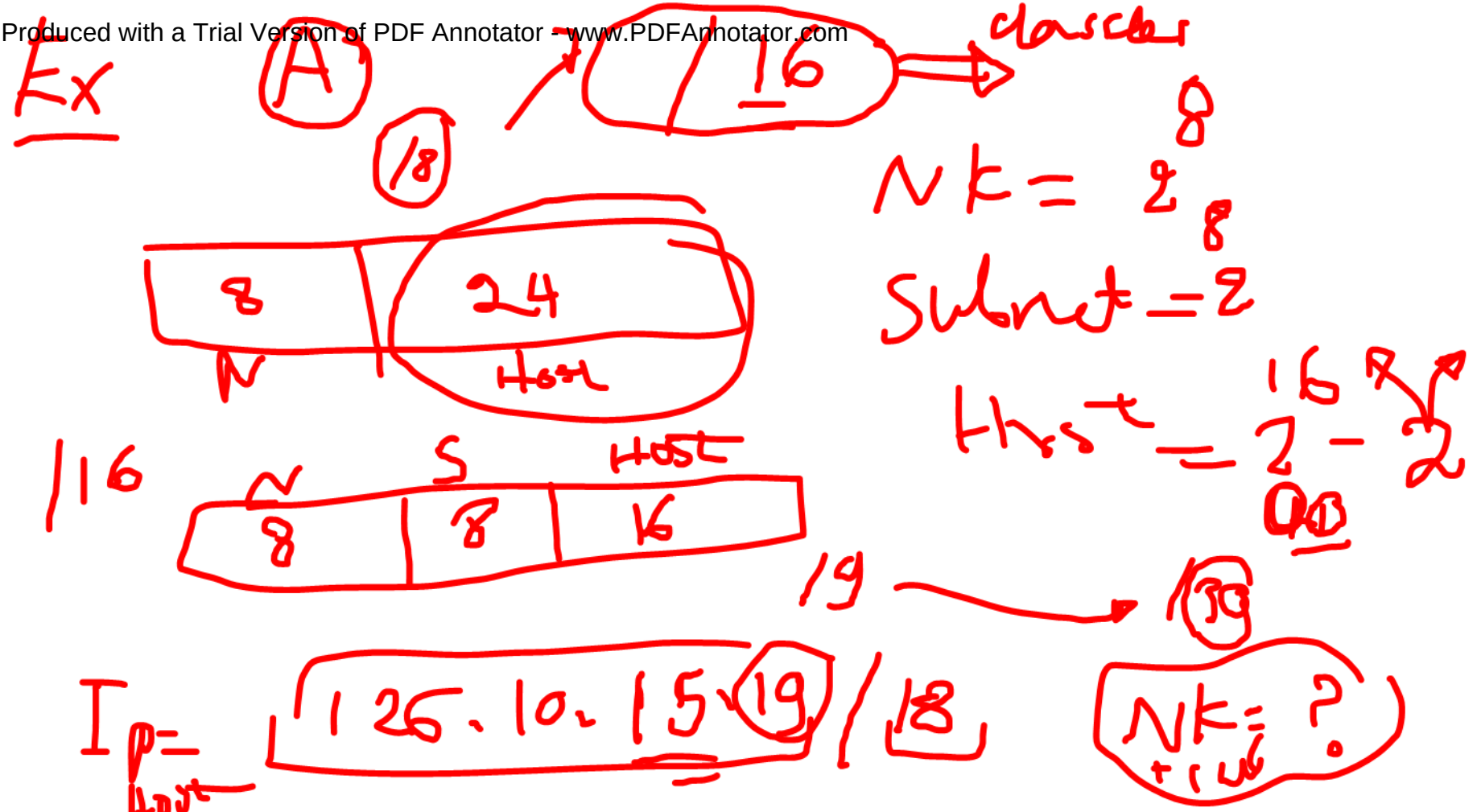








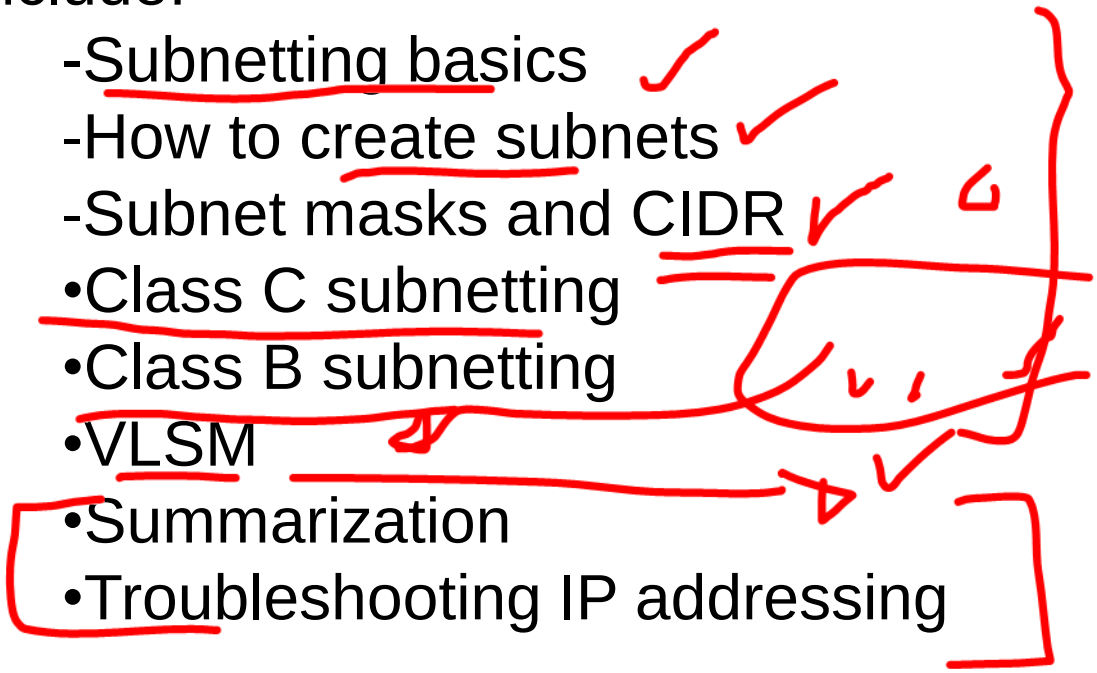
Ex



Chapter 3 Objectives

The CCNA Topics Covered in this chapter include:

- -Subnetting basics
- -How to create subnets
- -Subnet masks and CIDR
- •Class C subnetting
- •Class B subnetting
- •VLSM
- •Summarization
- •Troubleshooting IP addressing



def

18

mask class

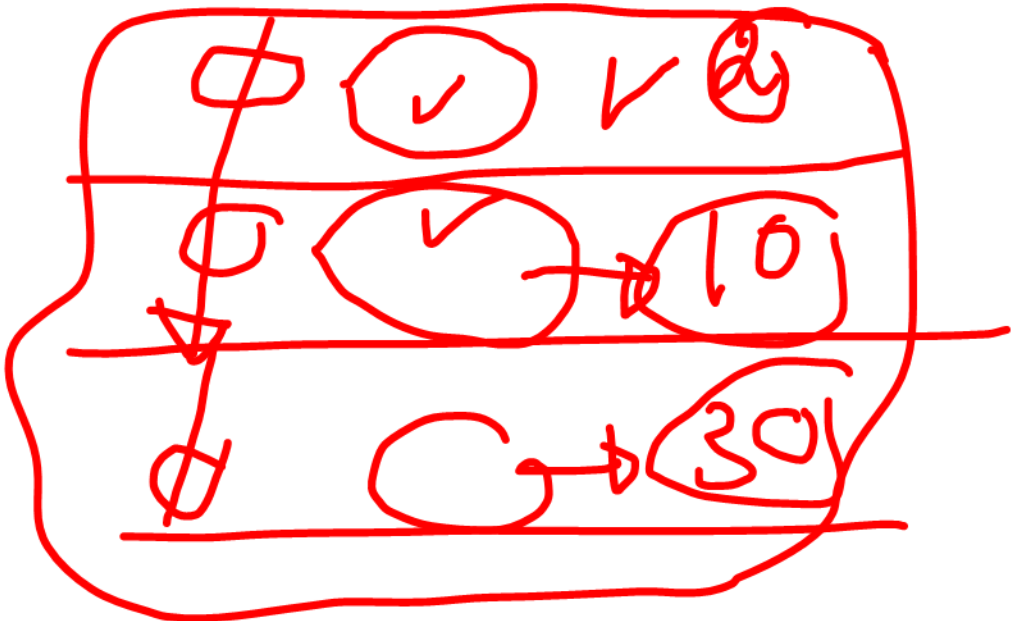
19 ... 130

Host

12

8 bit + 4 bit

111.1111.1111.0000.0000.

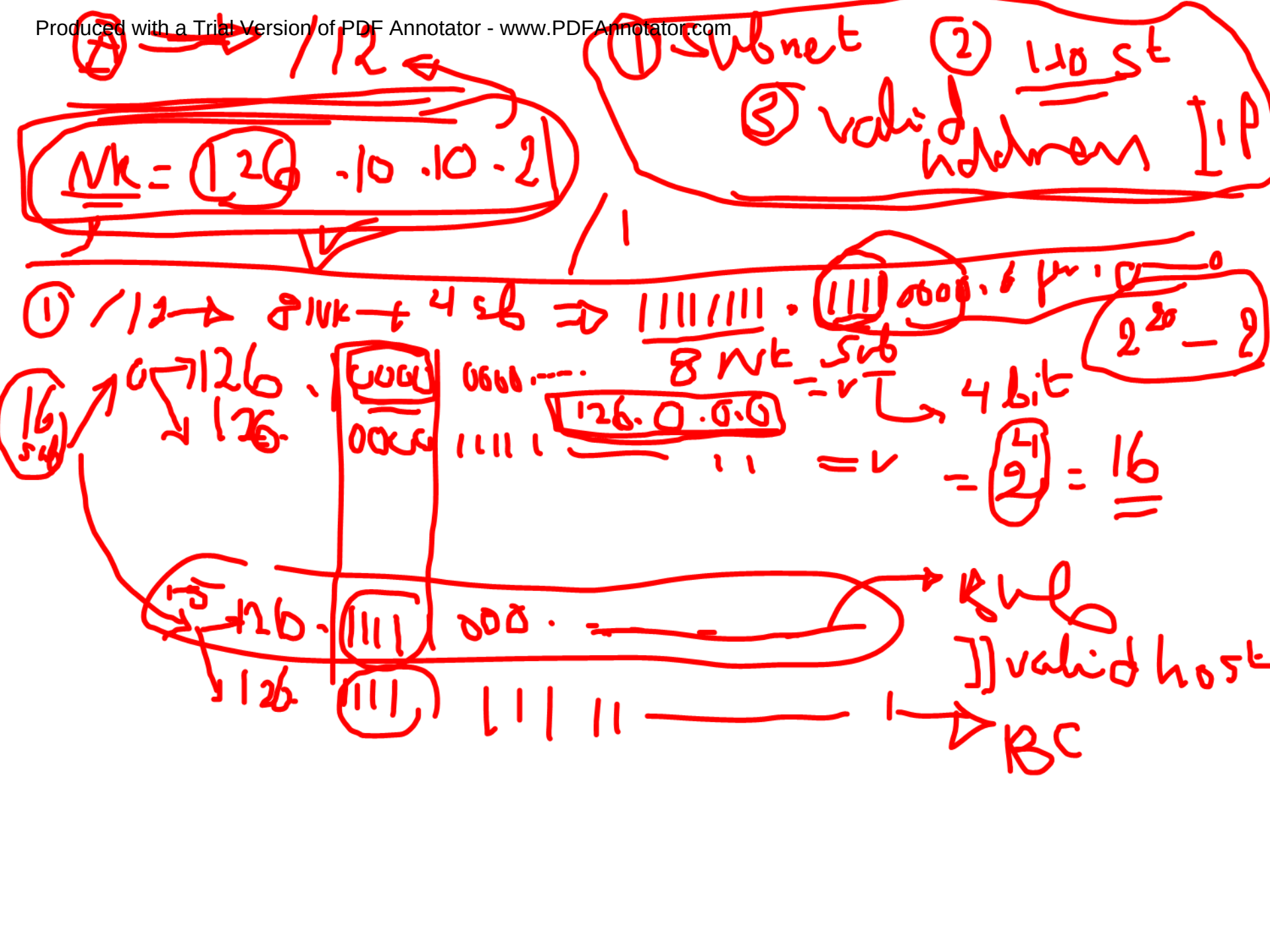


VLSM

Variable Length

2host

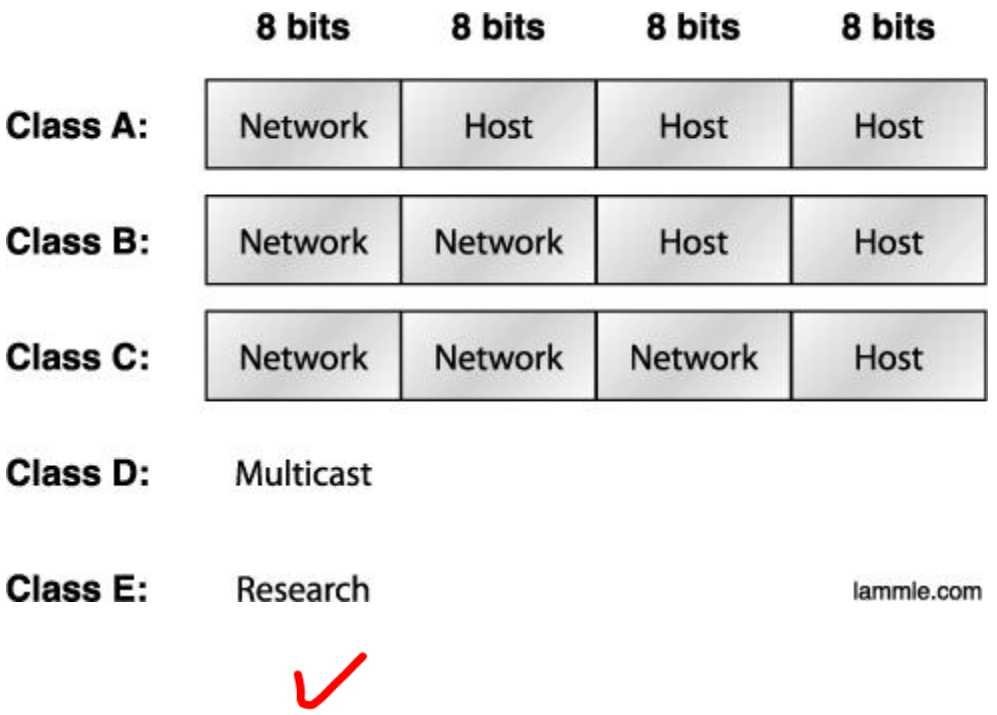
30host



SYBEX

Network Addressing

Subdividing an IP address into a network and node address is determined by the class designation of one's network. This figure summarizes the three classes of networks



0-127

128 - 191

192-223

224 - 239

240 - 225

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Private Addressing

Address Class	Reserved Address Space
Class A	10.0.0.0 through 10.255.255.255
Class B	172.16.0.0 through 172.31.255.255
Class C	192.168.0.0 through 192.168.255.255

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Subnetting Basics

- Benefits of subnetting include:
  - Reduced network traffic
  - Optimized network performance
  - Simplified management
  - Facilitated spanning of large geographical distances.

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How To Create Subnets

Take bits from the host portion of the IP address and reserve the to divine the subnet address.

1. Determine the number of required network IDs:
   - One for each subnet
   - One for each wide area network connection
2. Determine the number of required host IDs per subnet:
   - One for each TCP/IP host
   - One for each router interface
3. Based on the above requirement, create the following:
   - One subnet mask for your entire network
   - A unique subnet ID for each physical segment
   - A range of host IDs for each subnet

SYBEX

Understanding the Powers of 2

Understanding the Powers of 2

Powers of 2 are important to understand and memorize for use with IP subnetting. To review powers of 2, remember that when you see a number with another number to its upper right (called an exponent), this means you should multiply the number by itself as many times as the upper number specifies. For example, 2^3 is $2 \times 2 \times 2$, which equals 8. Here's a list of powers of 2 you should commit to memory:

$2^1 = 2$	$2^3 = 8$	$2^5 = 32$	$2^7 = 128$
$2^2 = 4$	$2^4 = 16$	$2^6 = 64$	$2^8 = 256$

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Subnet Masks

- Used to define which part of the host address will be used as the subnet address.
- A 32-bit value that allows the recipient of IP packets to distinguish the network ID portion of the IP address from the host ID portion.

Default Subnet Masks

Class	Format	Default Subnet Mask
A	*network.node.node.node*	255.0.0.0
B	*network.network.node.node*	255.255.0.0
C	*network.network.network.node*	255.255.255.0

Examples

you've got to keep at least 2 bits for host bits.

Take, for example, a Class A default subnet mask, which is 255.0.0.0. This means that the first byte of the subnet mask is all ones (1s), or 11111111. When referring to a slash notation, you need to count all the 1s bits to figure out your mask. The 255.0.0.0 is considered a /8 because it has 8 bits that are 1s—that is, 8 bits that are turned on.

A Class B default mask would be 255.255.0.0, which is a /16 because 16 bits are ones (1s): 11111111.11111111.00000000.00000000.

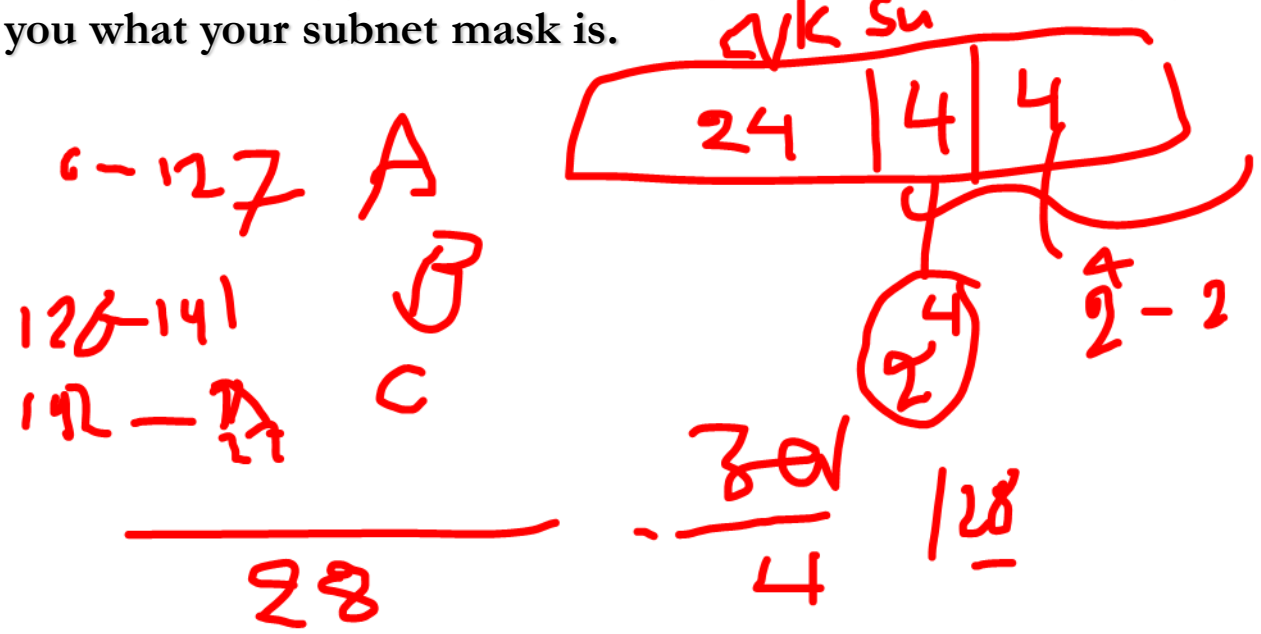
SYBEX

Classless Inter-Domain Routing (CIDR)

Used to allocate an amount of IP address space to a given entity (company, home, customer, etc).

Example: 192.168.10.32/28

The slash notation (/) means how many bits are turned on (1s) and tells you what your subnet mask is.



SYBEX

CIDR Values

Subnet Mask	CIDR Value
255.0.0.0	/8
255.128.0.0	/9
255.192.0.0	/10
255.224.0.0	/11
255.240.0.0	/12
255.248.0.0	/13
255.252.0.0	/14
255.254.0.0	/15
255.255.0.0	/16
255.255.128.0	/17
255.255.192.0	/18
255.255.224.0	/19
255.255.240.0	/20
255.255.248.0	/21

Subnet Mask	CIDR Value
255.255.252.0	/22
255.255.254.0	/23
255.255.255.0	/24
255.255.255.128	/25
255.255.255.192	/26
255.255.255.224	/27
255.255.255.240	/28
255.255.255.248	/29
255.255.255.252	/30

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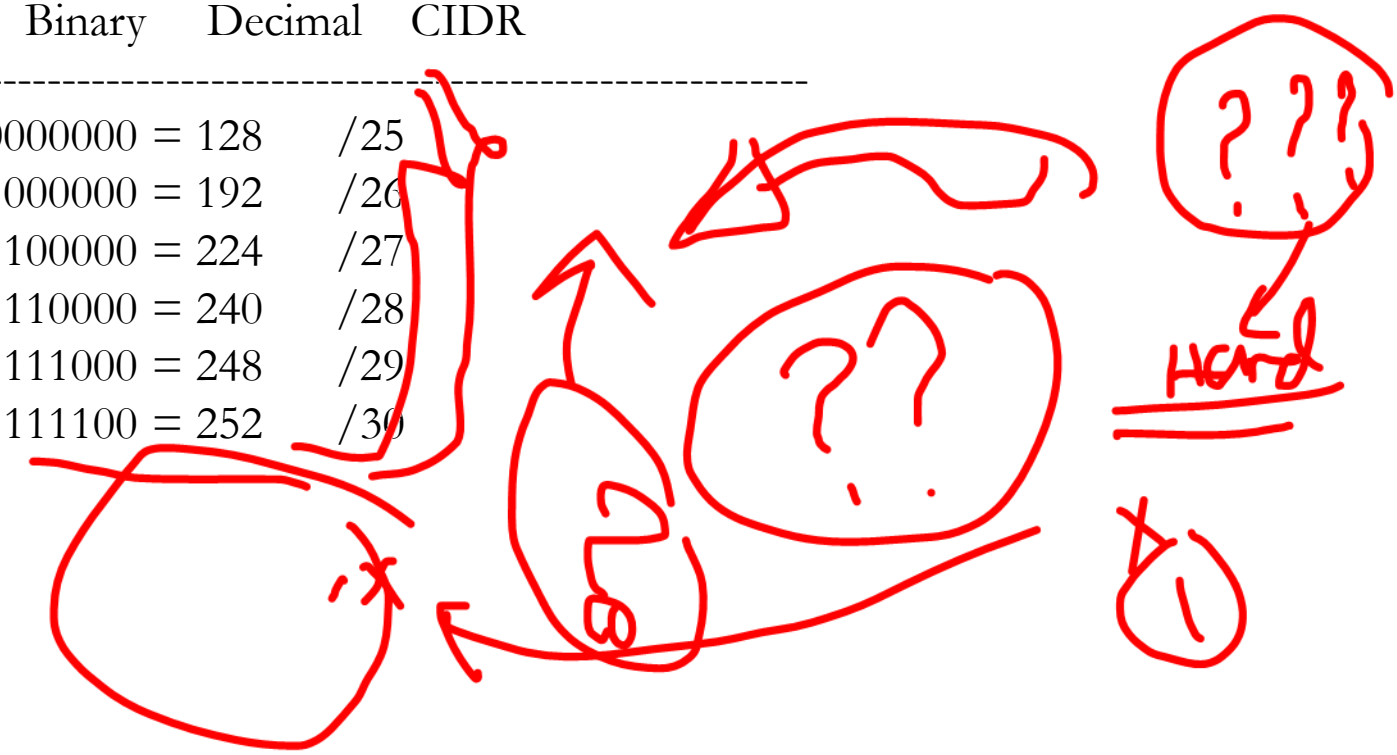
Subnetting Class C Addresses

In a Class C address, only 8 bits are available for defining the hosts. Remember that subnet bits start at the left and go to the right, without skipping bits. This means that the only Class C subnet masks can be the following:

Binary	Decimal	CIDR
10000000	= 128	/25
11000000	= 192	/26
11100000	= 224	/27
11110000	= 240	/28
11111000	= 248	/29
11111100	= 252	/30



SYBEX

Class C 192 mask examples

Subnet	Host	Meaning
00	000000 = 0	The network (do this first)
00	000001 = 1	The first valid host
00	111110 = 62	The last valid host
00	111111 = 63	The broadcast address (do this second)

Subnet	Host	Meaning
01	000000 = 64	The network
01	000001 = 65	The first valid host
01	111110 = 126	The last valid host
01	111111 = 127	The broadcast address

Class C 192 mask examples

Subnet	Host	Meaning
10	000000 = 128	The subnet address
10	000001 = 129	The first valid host
10	111110 = 190	The last valid host
10	111111 = 191	The broadcast address

Subnet	Host	Meaning
11	000000 = 192	The subnet address
11	000001 = 193	The first valid host
11	111110 = 254	The last valid host
11	111111 = 255	The broadcast address

Subnetting Class C Addresses – Fast Method

Answer Five Simple Questions:

- How many subnets does the chosen subnet mask produce?
- How many valid hosts per subnet are available?
- What are the valid subnets?
- What's the broadcast address of each subnet?
- What are the valid hosts in each subnet?

How Many Subnets?

2^2 = number of subnets.

- X is the number of masked bits, or the 1s.
- For example, in 11000000, the number of ones gives us 2^2 subnets. In this example there are 4 subnets.

How Many Hosts Per Subnet?

2^y-2 = number of hosts per subnet.

- Y is the number of unmasked bits, or the 0s.
- For example, in 11000000, the number of zeros gives us 2^6-2 hosts. In this example, there are 62 hosts per subnet.

What Are The Valid Subnets?

- 256-subnet mask = block size, or base number.
- For example 256-192=64. 64 is the first subnet. The next subnet would be the base number plus itself or 64+64=128, (the second subnet).

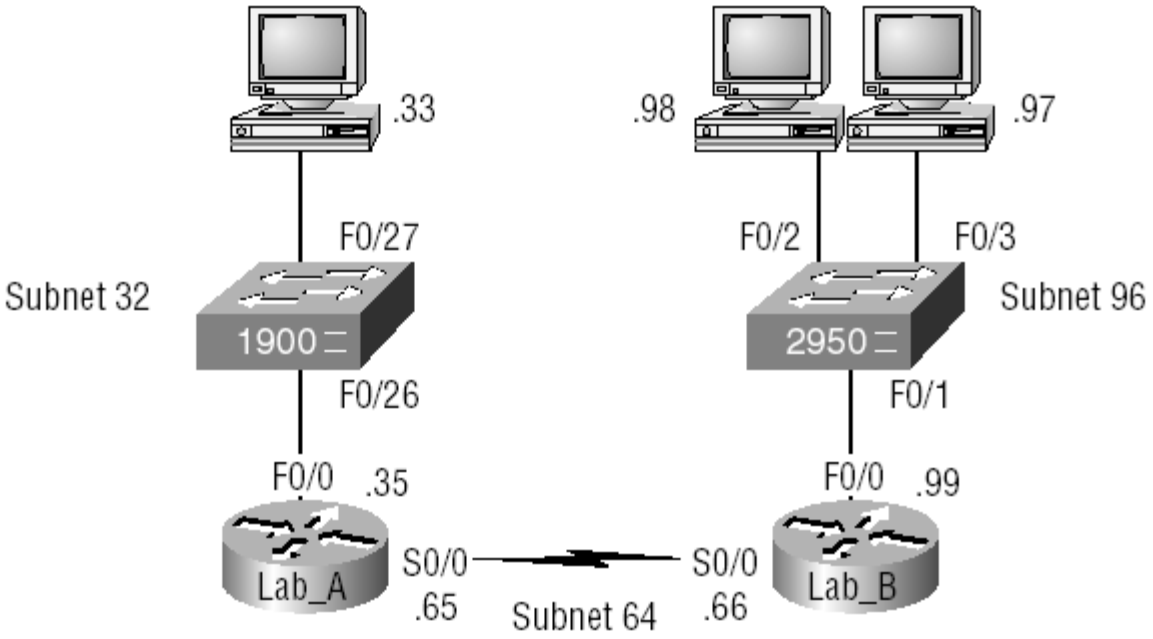
What's The Broadcast Address For Each Subnet?

- The broadcast address is all host bits turned on, which is the number immediately preceding the next subnet.

What Are The Valid Hosts?

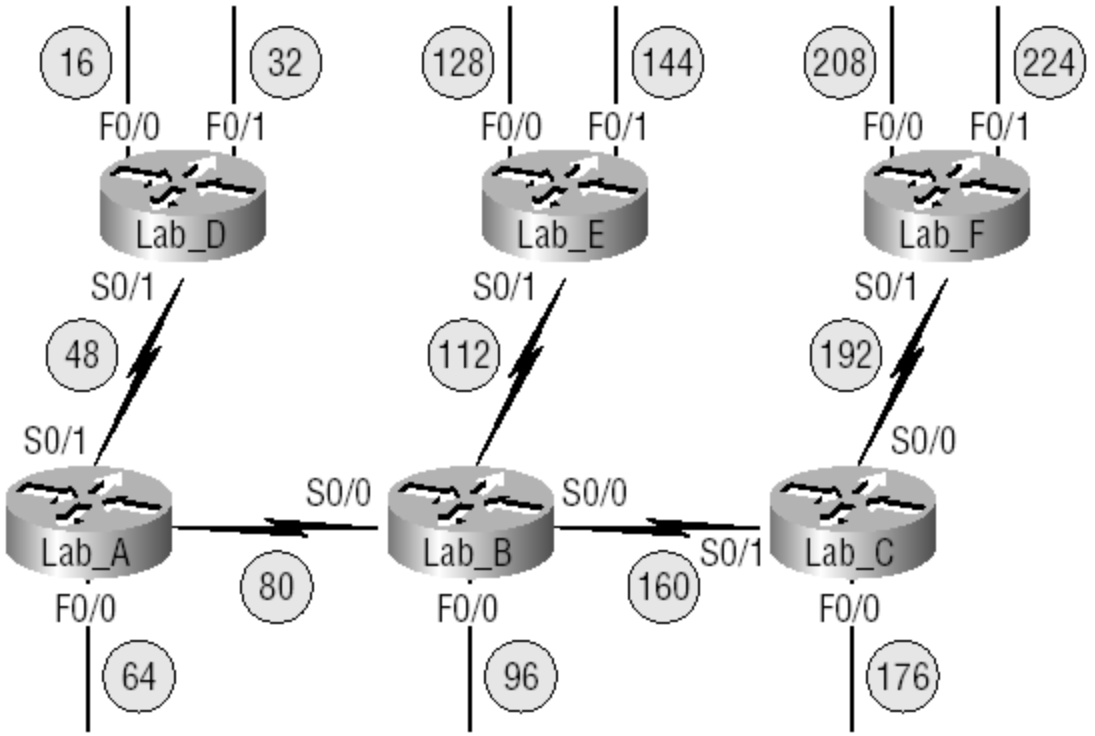
- Valid hosts are the number between the subnets, omitting all 0s and all 1s.

Variable Length Subnet Masks (VLSM)



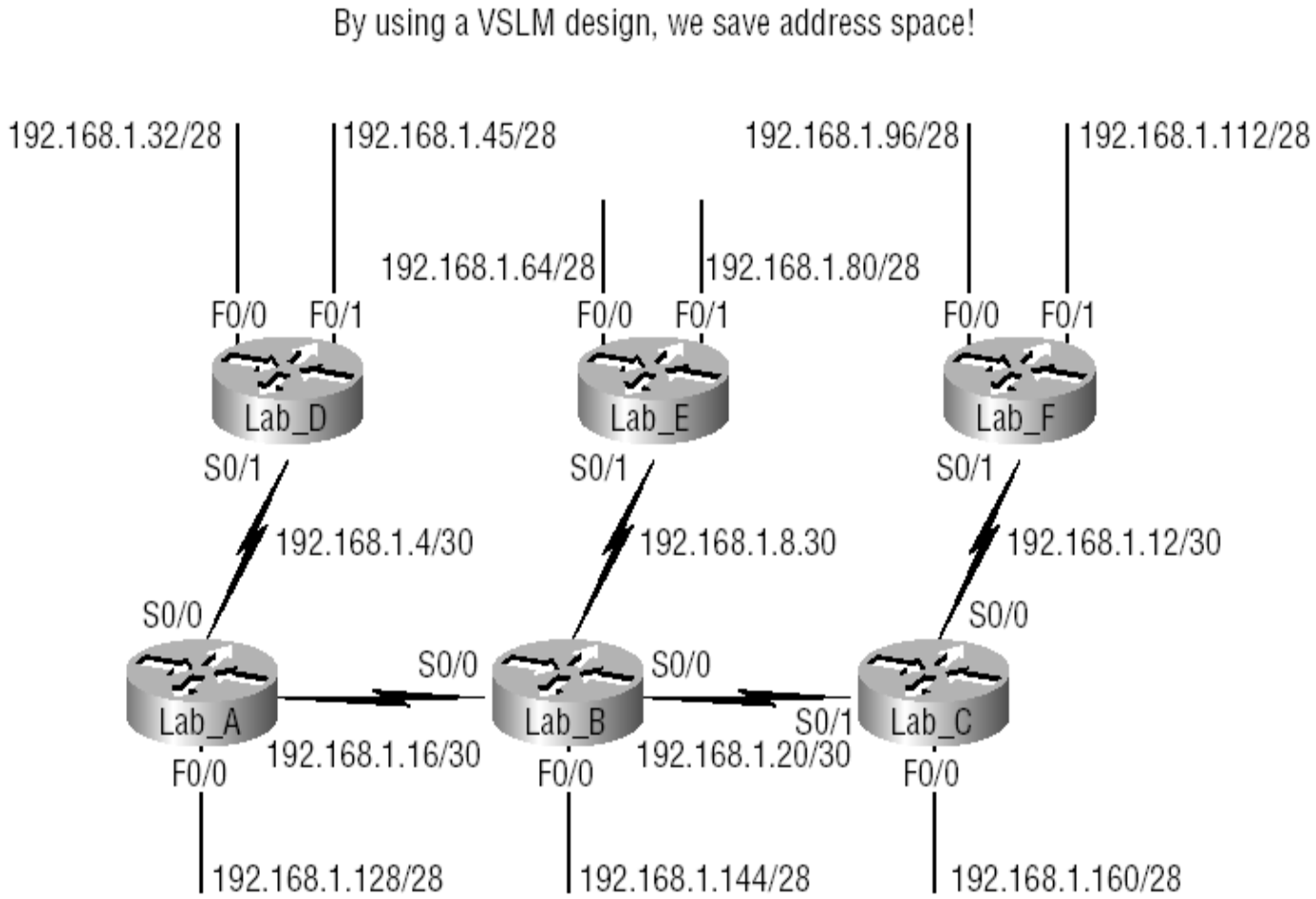
Subnets with no VLSM applied

The mask of 255.255.255.240 (/28) provides 14 subnets, each with 14 hosts. All hosts and router interfaces use the same subnet mask.



Subnets with VLSM applied

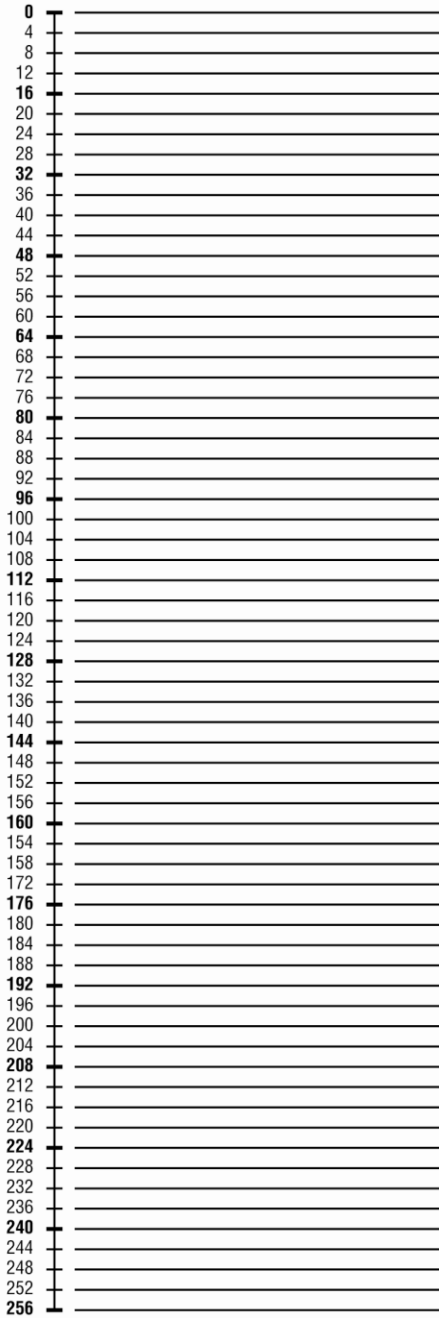
RE 3.3 Fourteen subnets with VLSM applied



SYBEX

Variable Length Subnet Masks Worksheet

Subnet	Mask	Subnets	Hosts	Block
/26	192	4	62	64
/27	224	8	30	32
/28	240	16	14	16
/29	248	32	6	8
/30	252	64	2	4



Class C Network 192.168.10.0

Network	Hosts	Block	Subnet	Mask
A				
B				
C				
D				
E				
F				
G				
H				
I				
J				
K				
L				
M				

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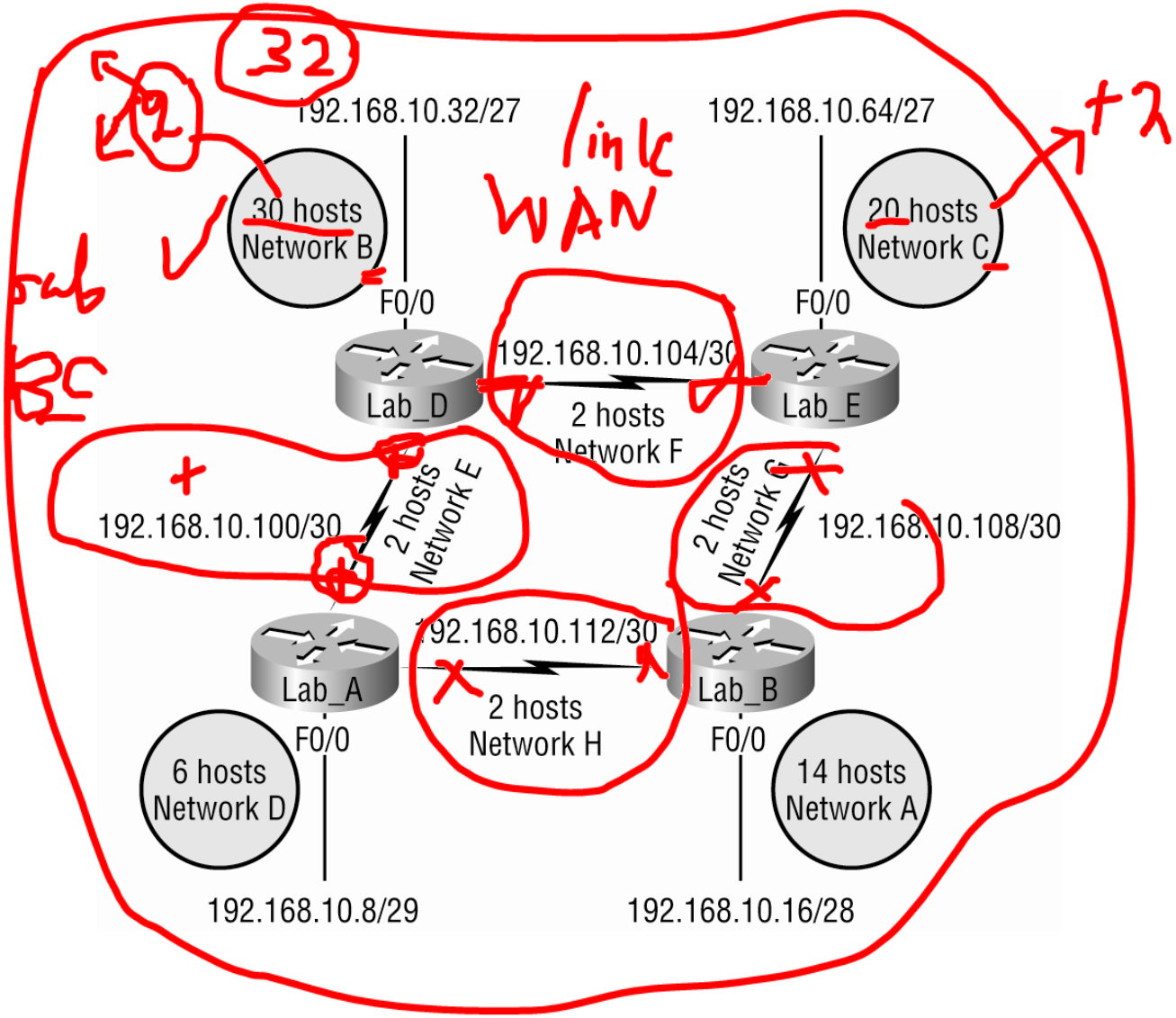
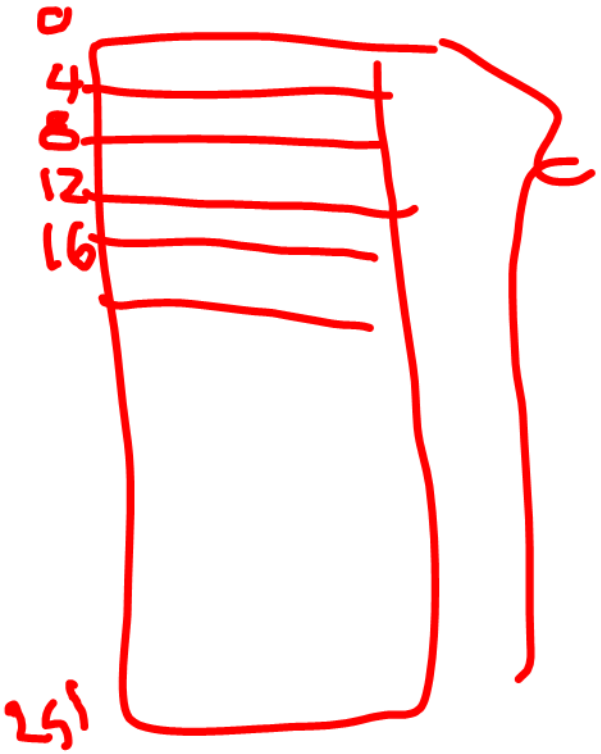
VSLM, Example 1





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Subnet	Mask	Subnets	Hosts	Block
/26	192	4	62	64
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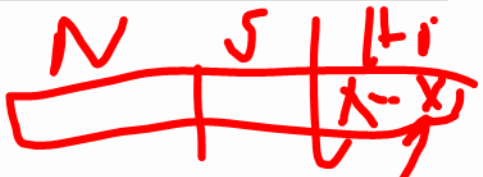
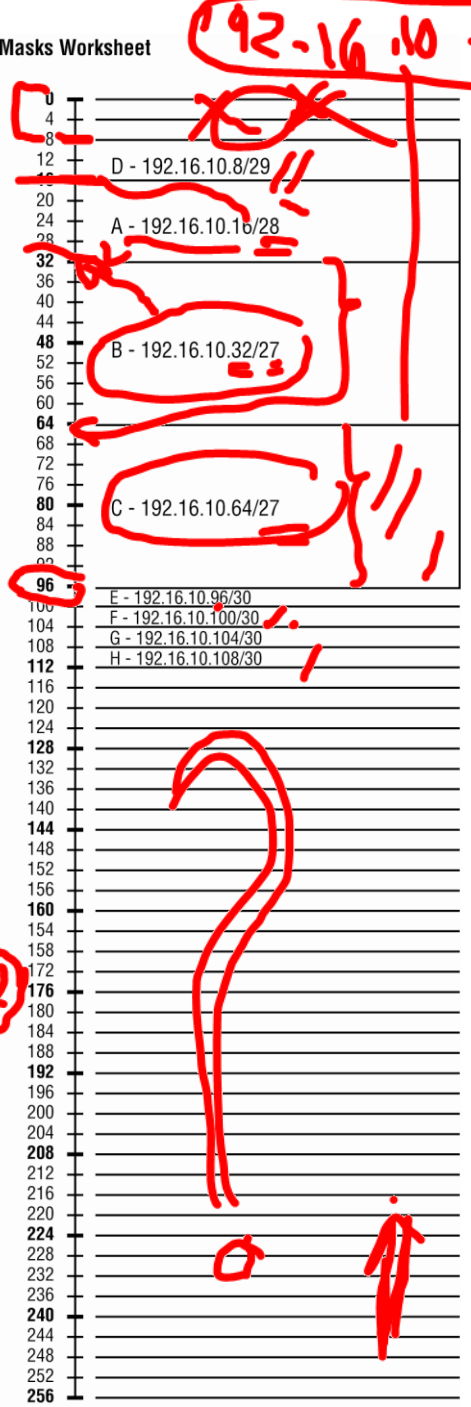
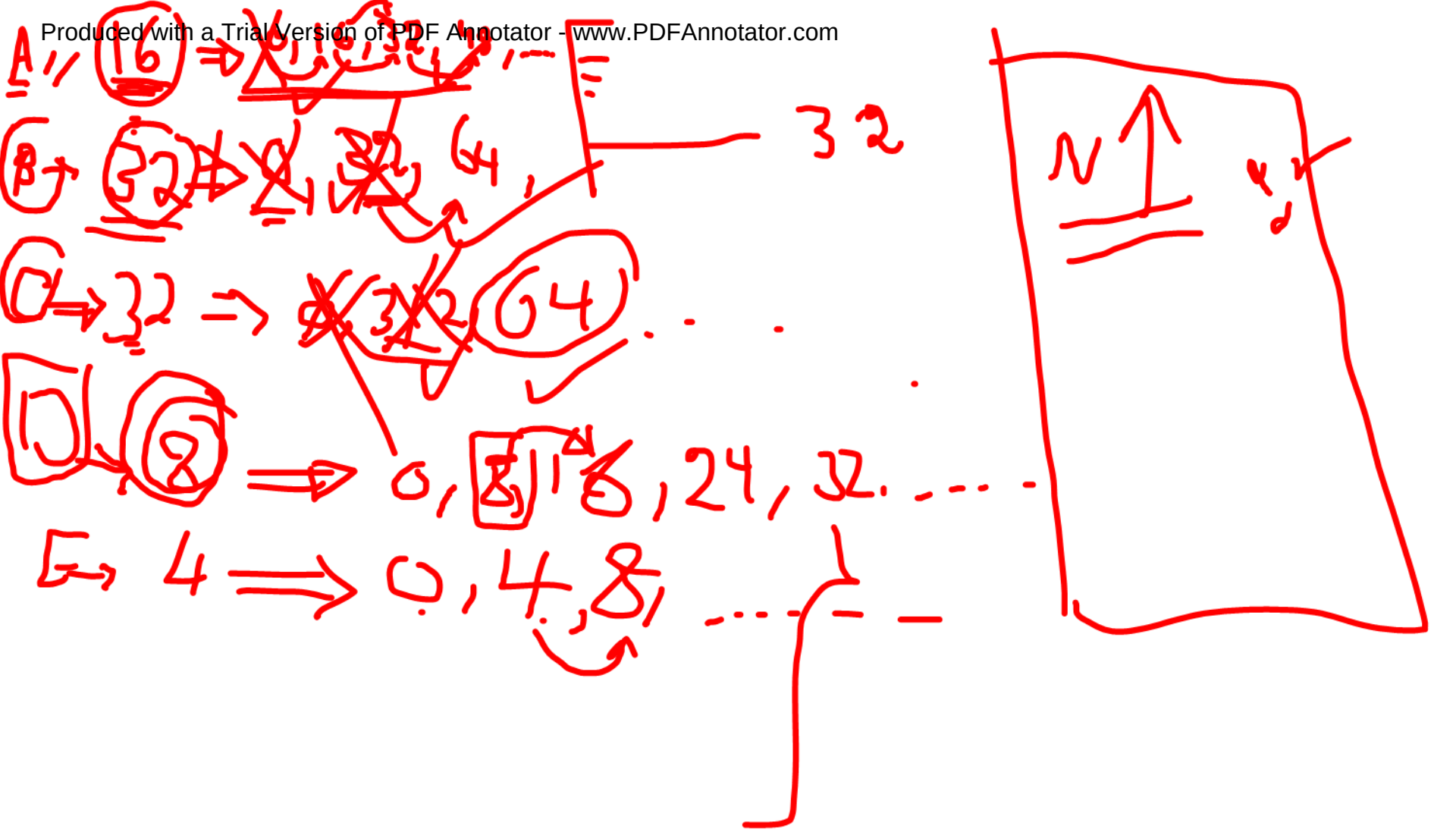
/28	240	16	14	16
/29	248	32	6	8
/30	252	64	2	4



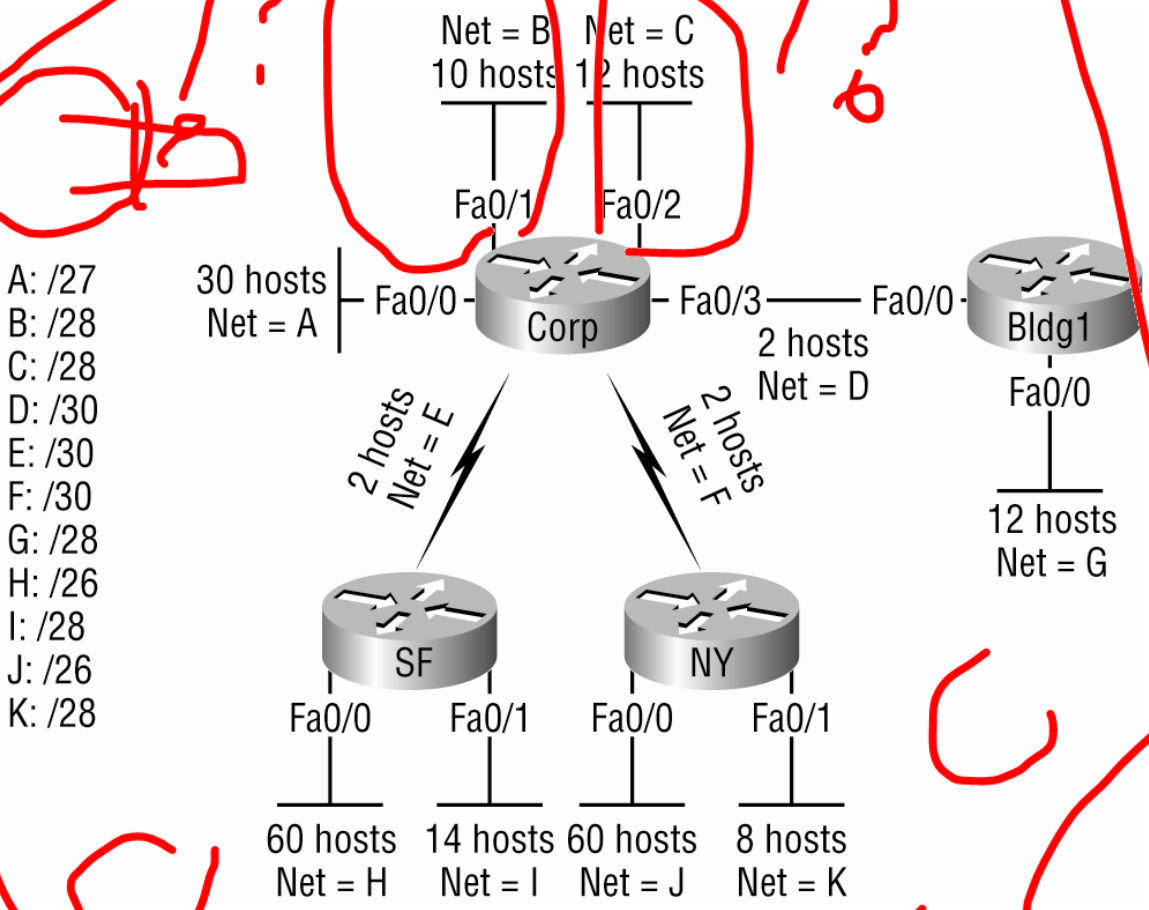


Class C Network 192.16.10.0

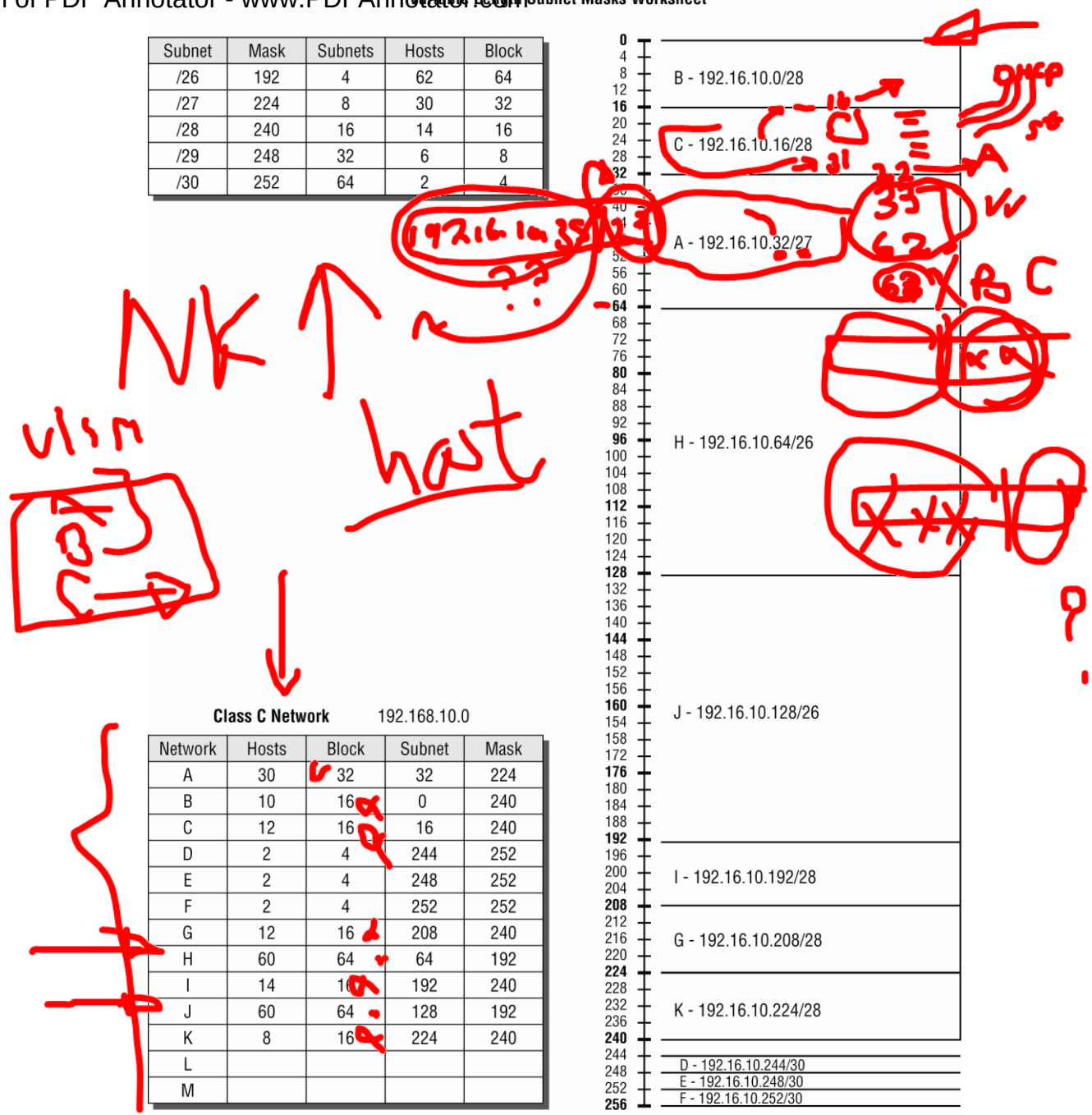
Network	Hosts	Block	Subnet	Mask
A	12	16	/28	240
B	20	32	/27	224
C	25	32	/27	224
D	4	8	/29	248
E	2	4	/30	252
F	2	4	/30	252
G	2	4	/30	252
H	2	4	/30	252



VLSM, Example 2

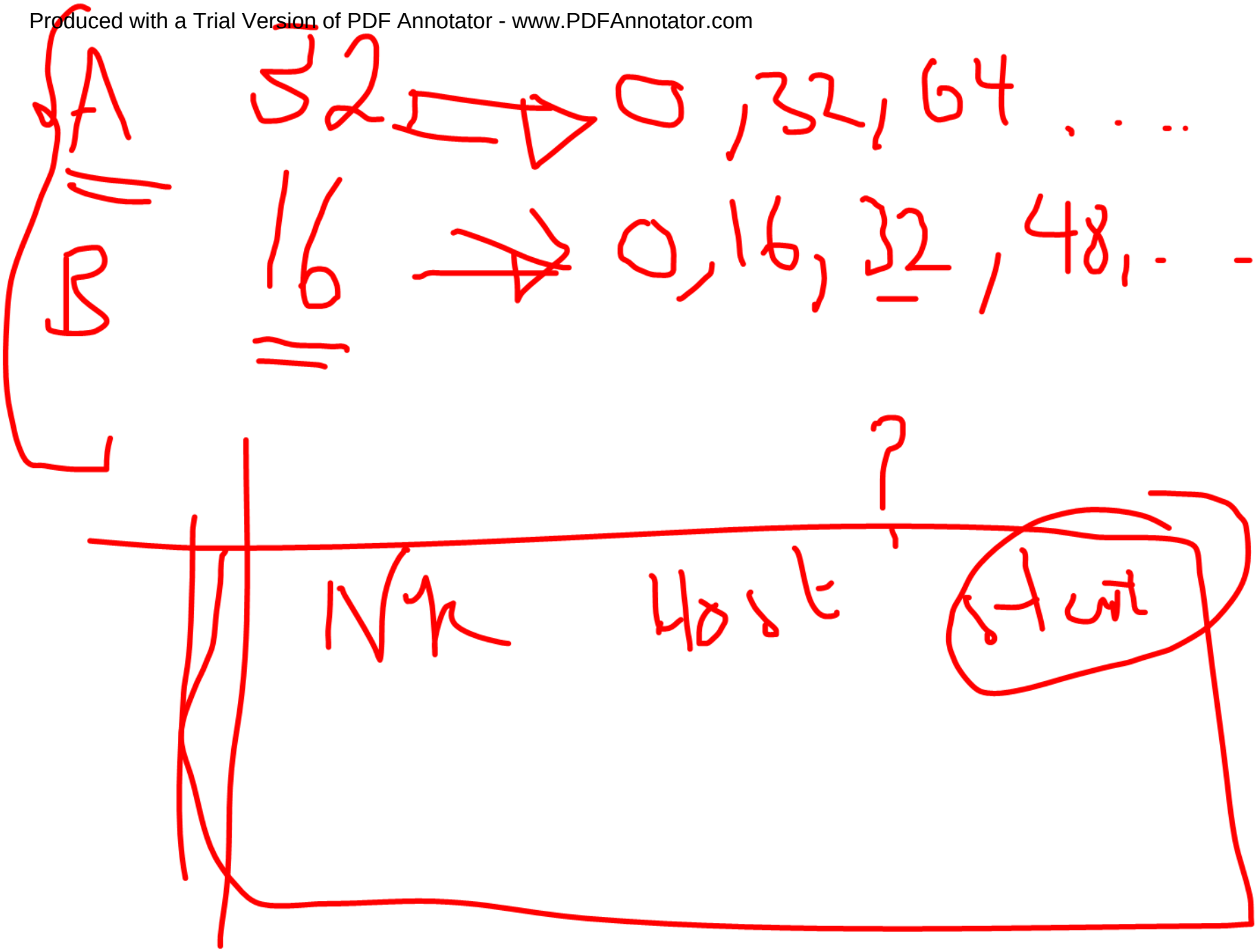


Subnet	Mask	Subnets	Hosts	Block
/26	192	4	62	64
/27	224	8	30	32
/28	240	16	14	16
/29	248	32	6	8
/30	252	64	2	4

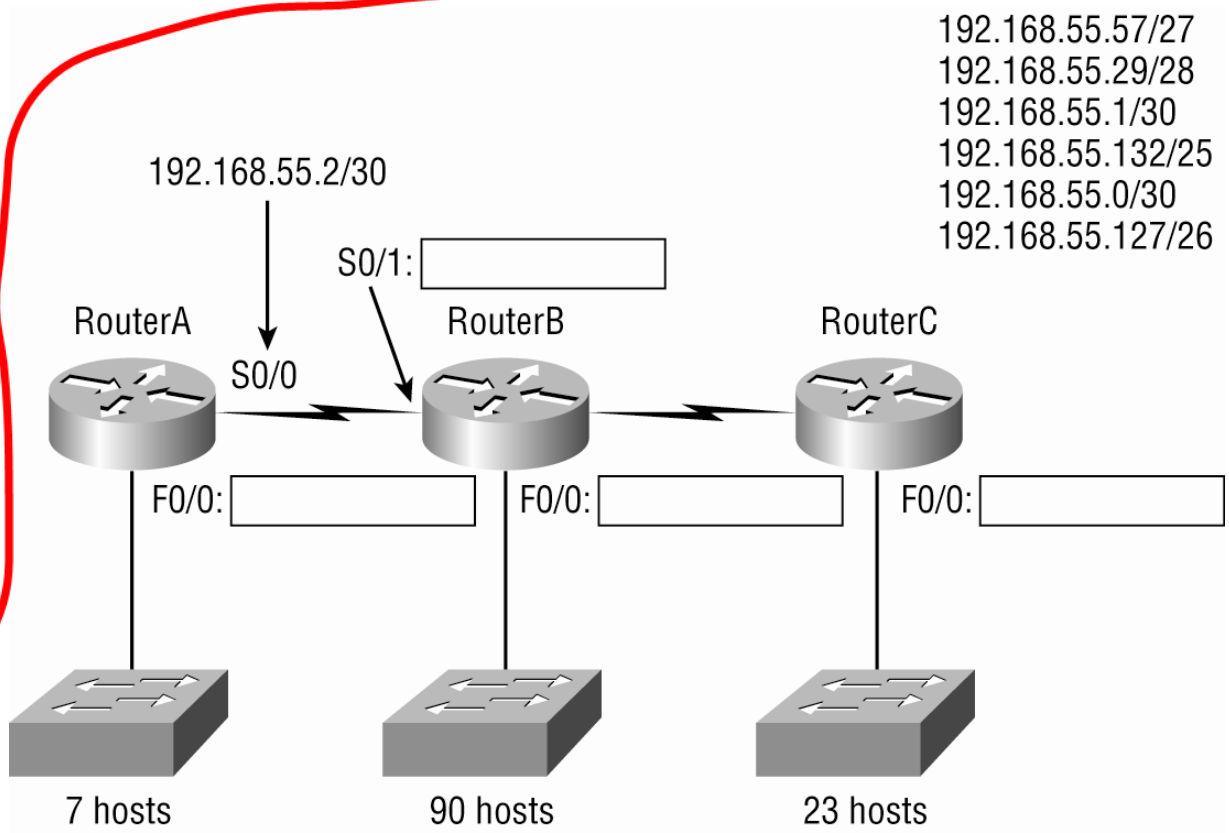


Class C Network 192.168.10.0

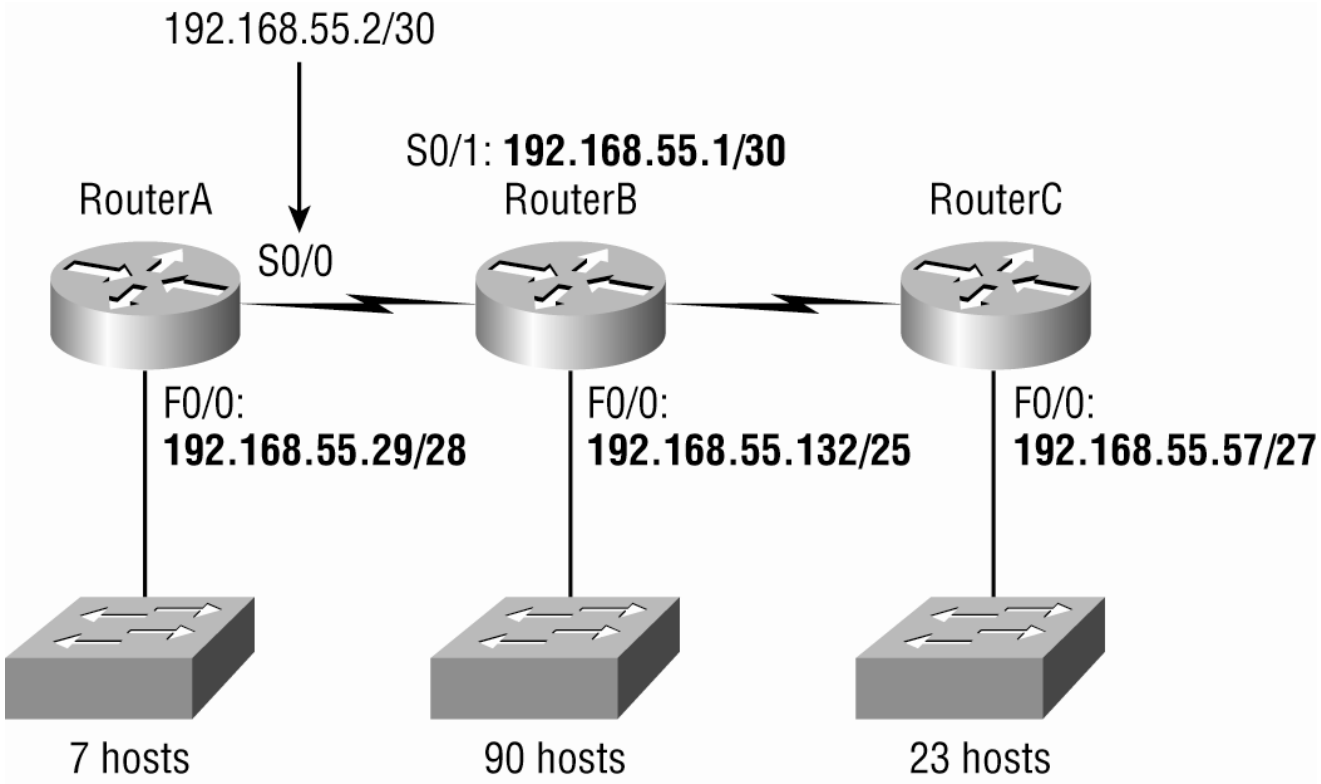
Network	Hosts	Block	Subnet	Mask
A	30	32	32	224
B	10	16	0	240
C	12	16	16	240
D	2	4	244	252
E	2	4	248	252
F	2	4	252	252
G	12	16	208	240
H	60	64	64	192
I	14	16	192	240
J	60	64	128	192
K	8	16	224	240
L				
M				



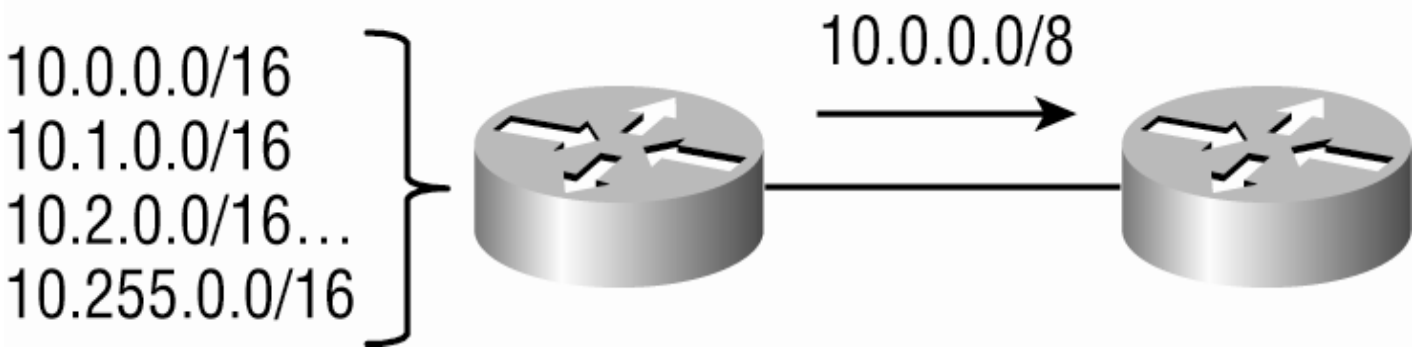
Which IP address will be placed in each router's FastEthernet 0/0 interface and serial 0/1 of RouterB?



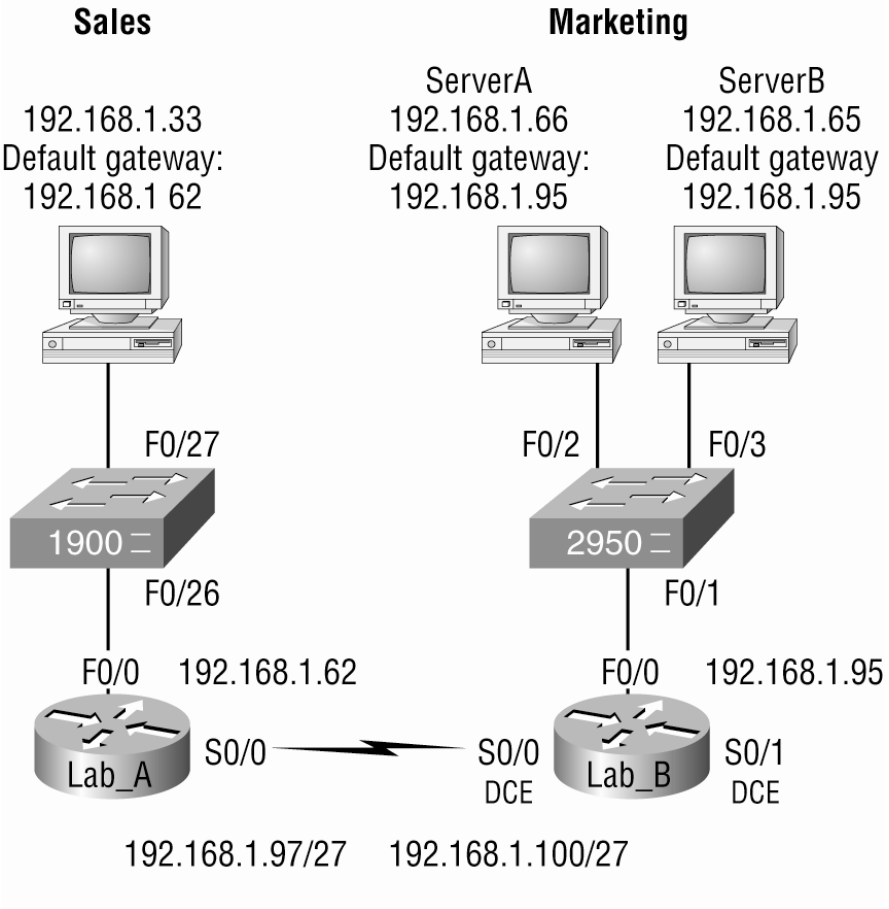
Answer


192.168.55.2/30
S0/1: 192.168.55.1/30
RouterA
RouterB
RouterC
S0/0
F0/0:
192.168.55.29/28
F0/0:
192.168.55.132/25
F0/0:
192.168.55.57/27
7 hosts
90 hosts
23 hosts

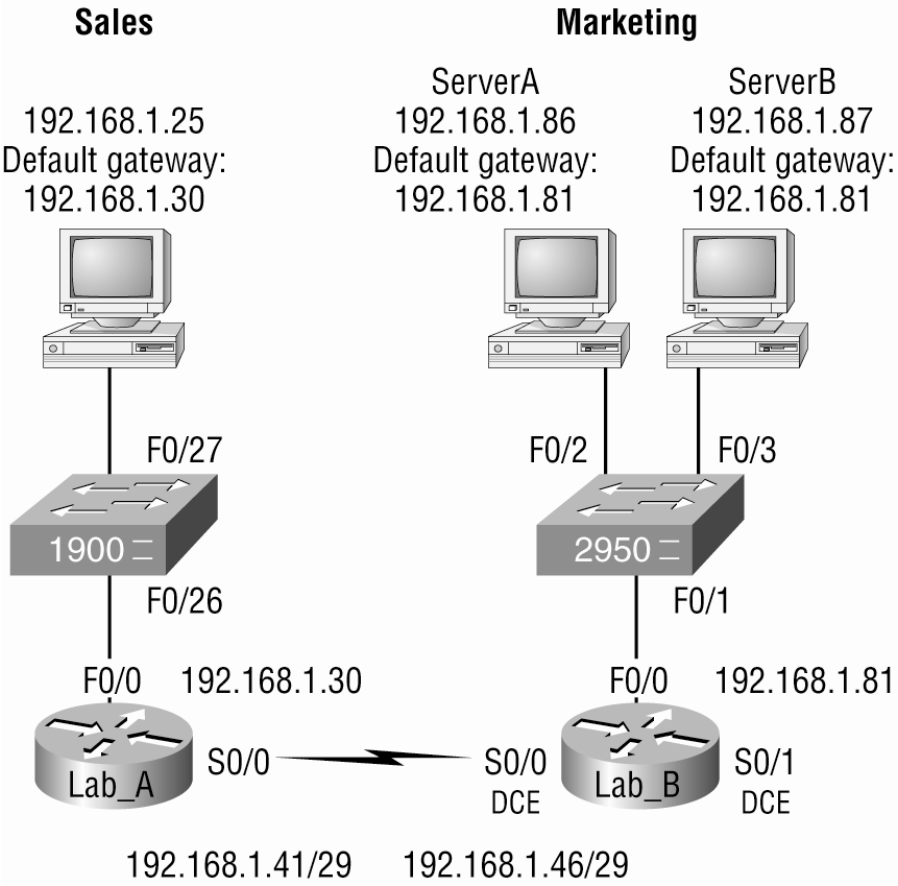
Summary Example



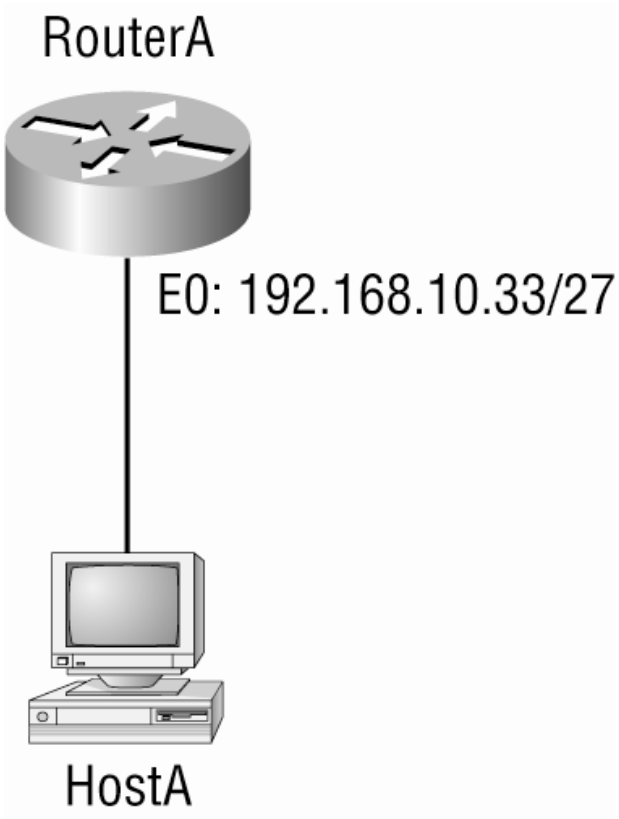
Why can't the Sales LAN get to Server A?



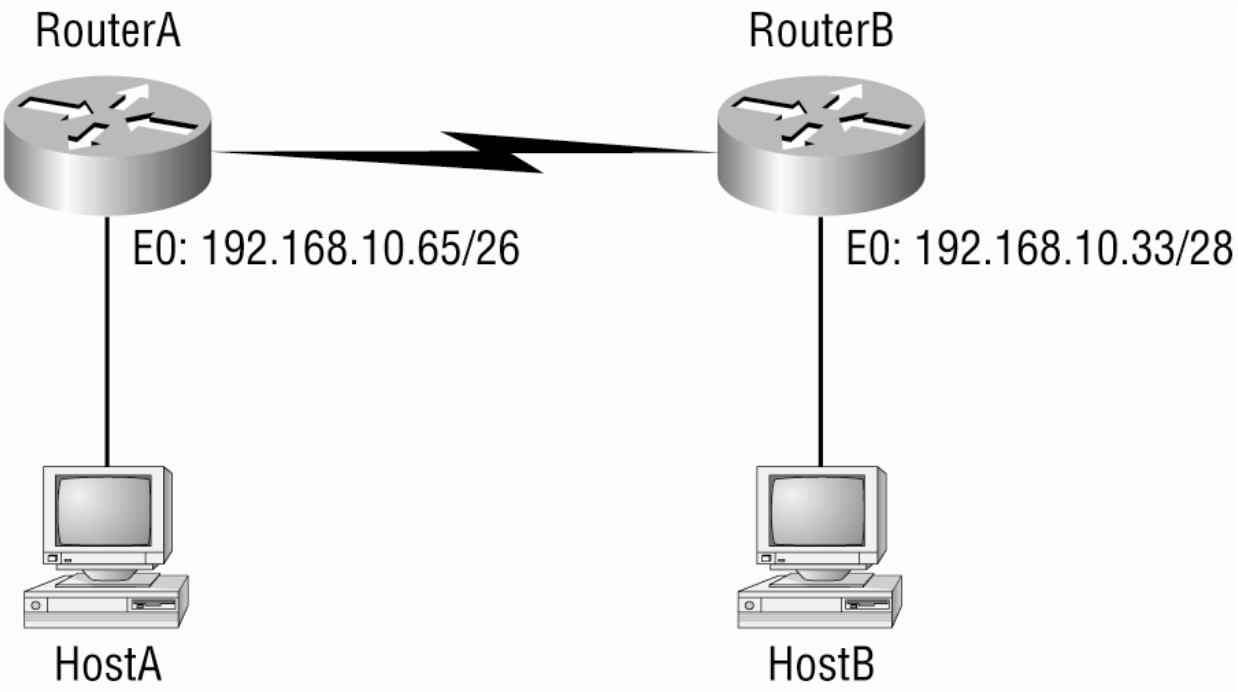
Why can't hosts in the Sales LAN get to Server B?



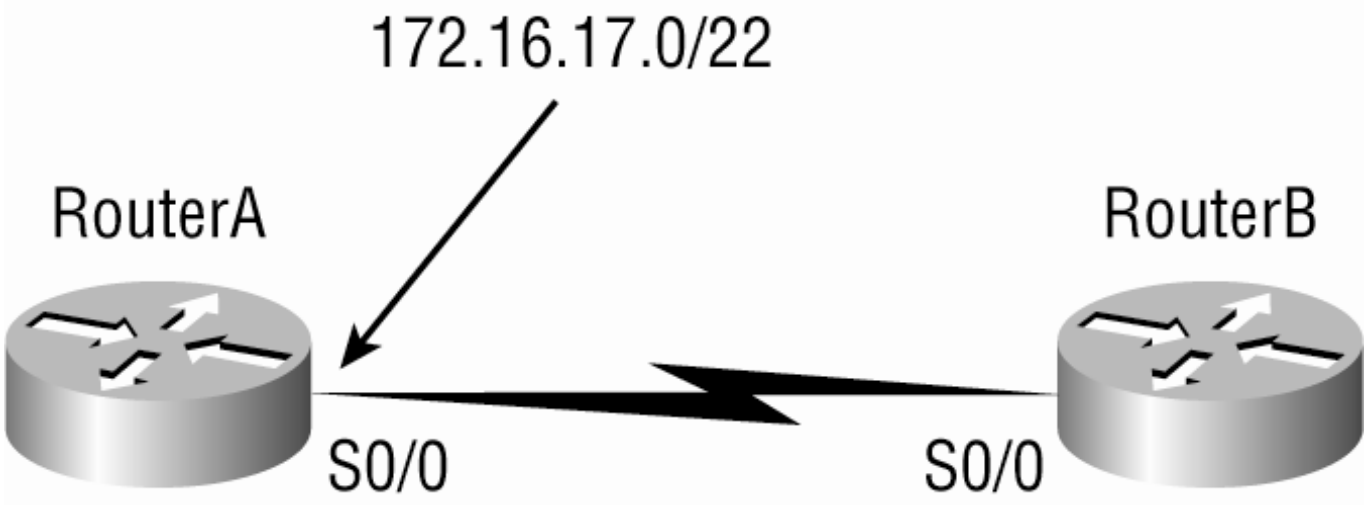
What can the host address be?



Which addresses can you assign to the hosts?



Which IP addresses can you assign?



Summary

- Go through all written and review questions
- Review answers in class