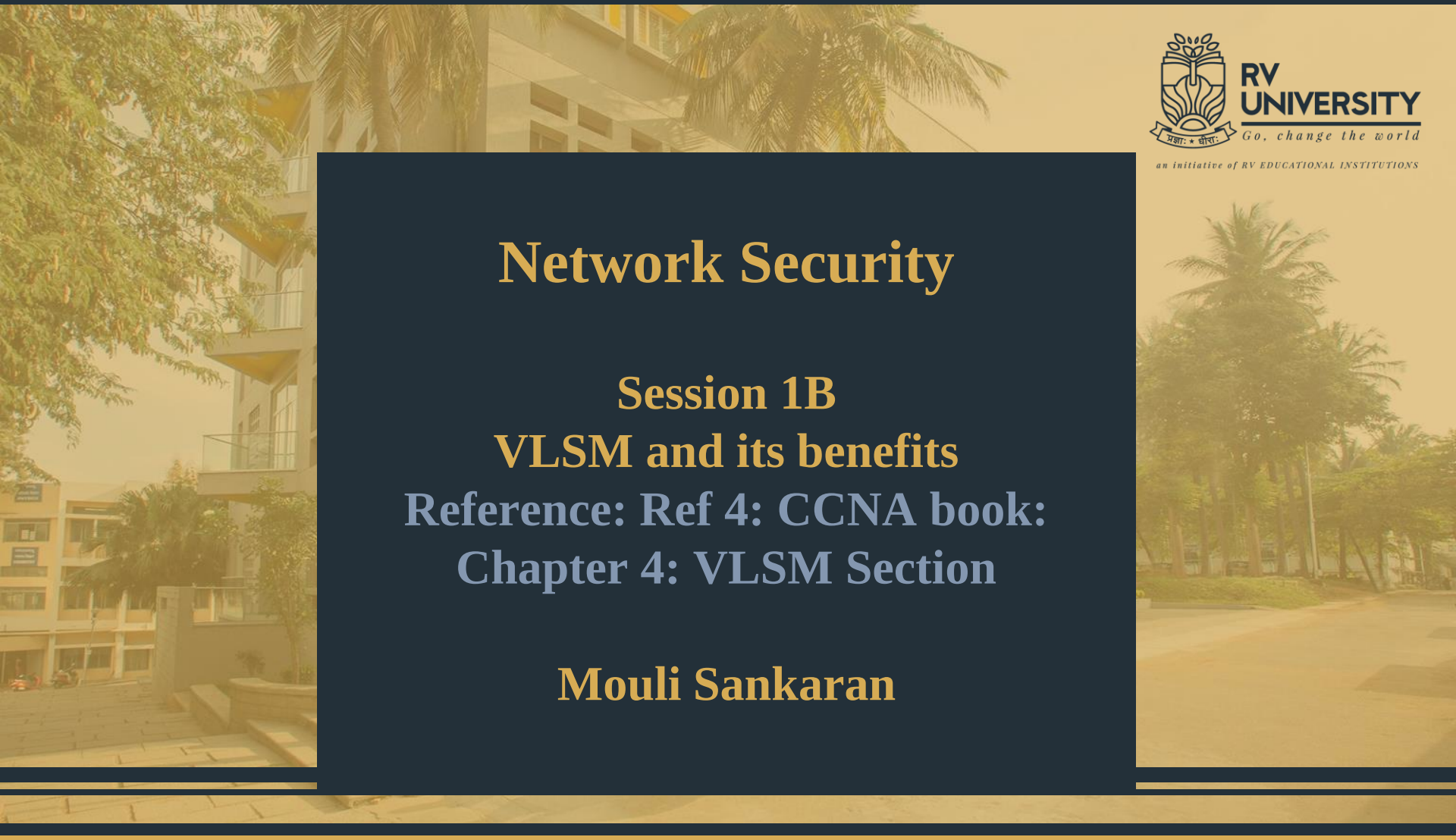


RV UNIVERSITY
Go, change the world
an initiative of RV EDUCATIONAL INSTITUTIONS

Network Security

Session 1B
VLSM and its benefits
Reference: Ref 4: CCNA book: Chapter 4: VLSM Section

Mouli Sankaran

RV UNIVERSITY
Go, change the world
an initiative of RV EDUCATIONAL INSTITUTIONS

Session 1B: Focus

- Example 0 Network and need for VLSM
- VLSM Explained
- Benefits of VLSM
- VLSM Design
  - Standard Block Sizes (no. of hosts)
  - VLSM Table
- Example 1: VLSM Implementation
- Example 2: VLSM Implementation
  - Understand it by reading the CCNA book - Homework

Course page where the course materials will be posted as the course progresses:

Focus

- Example 0 Network and need for VLSM
- VLSM Explained
- Benefits of VLSM
- VLSM Design
  - Standard Block Sizes (no. of hosts)
  - VLSM Table
- Example 1: VLSM Implementation
- Example 2: VLSM Implementation
  - Understand it by reading the CCNA book - Homework

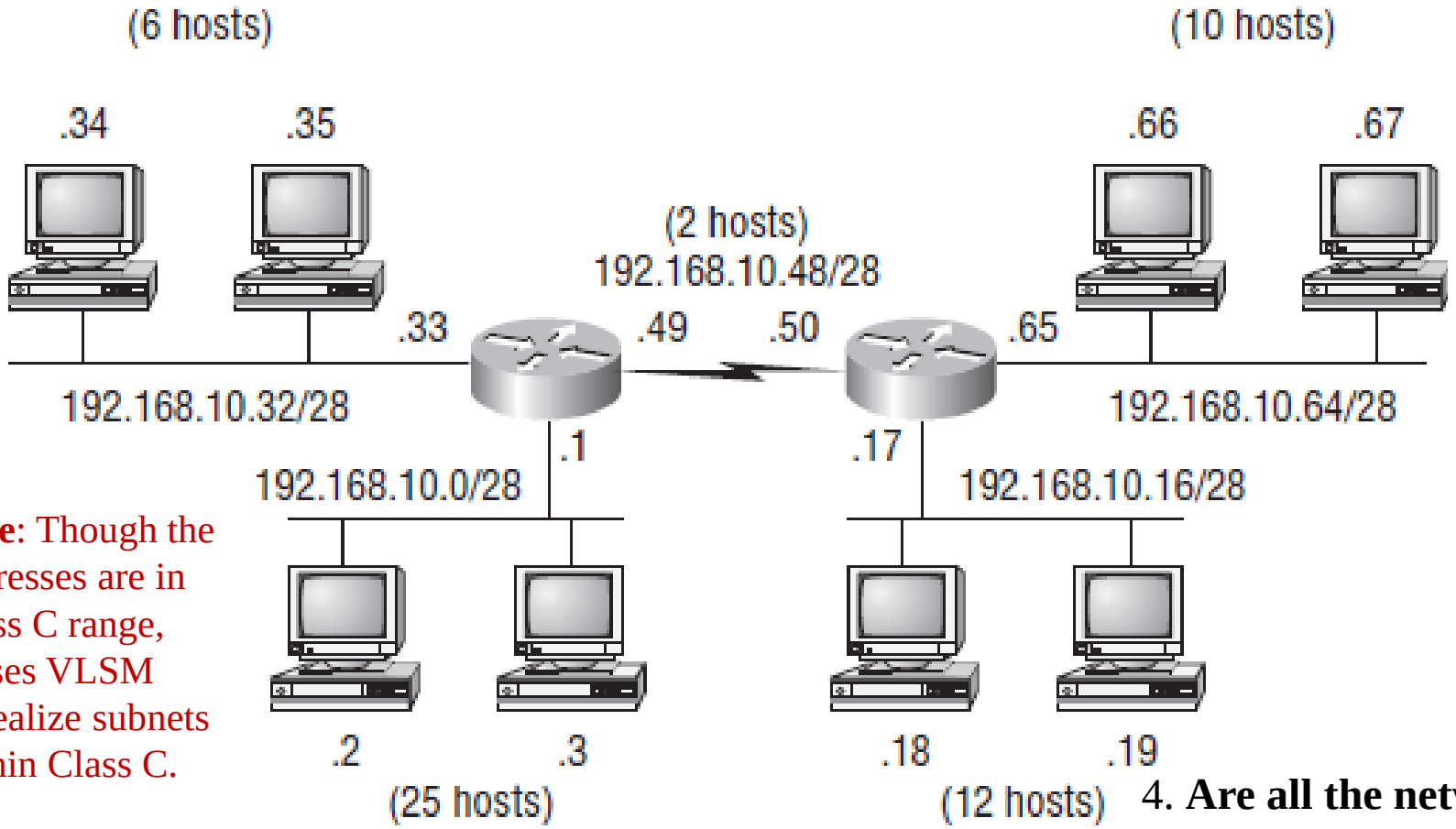
Course page where the course materials will be posted as the course progresses:

VLSM

VLSM: Variable Length Subnet Masking

Example 0 Network

- Observe the network below and give your answers:



Note: Though the addresses are in Class C range, it uses VLSM to realize subnets within Class C.

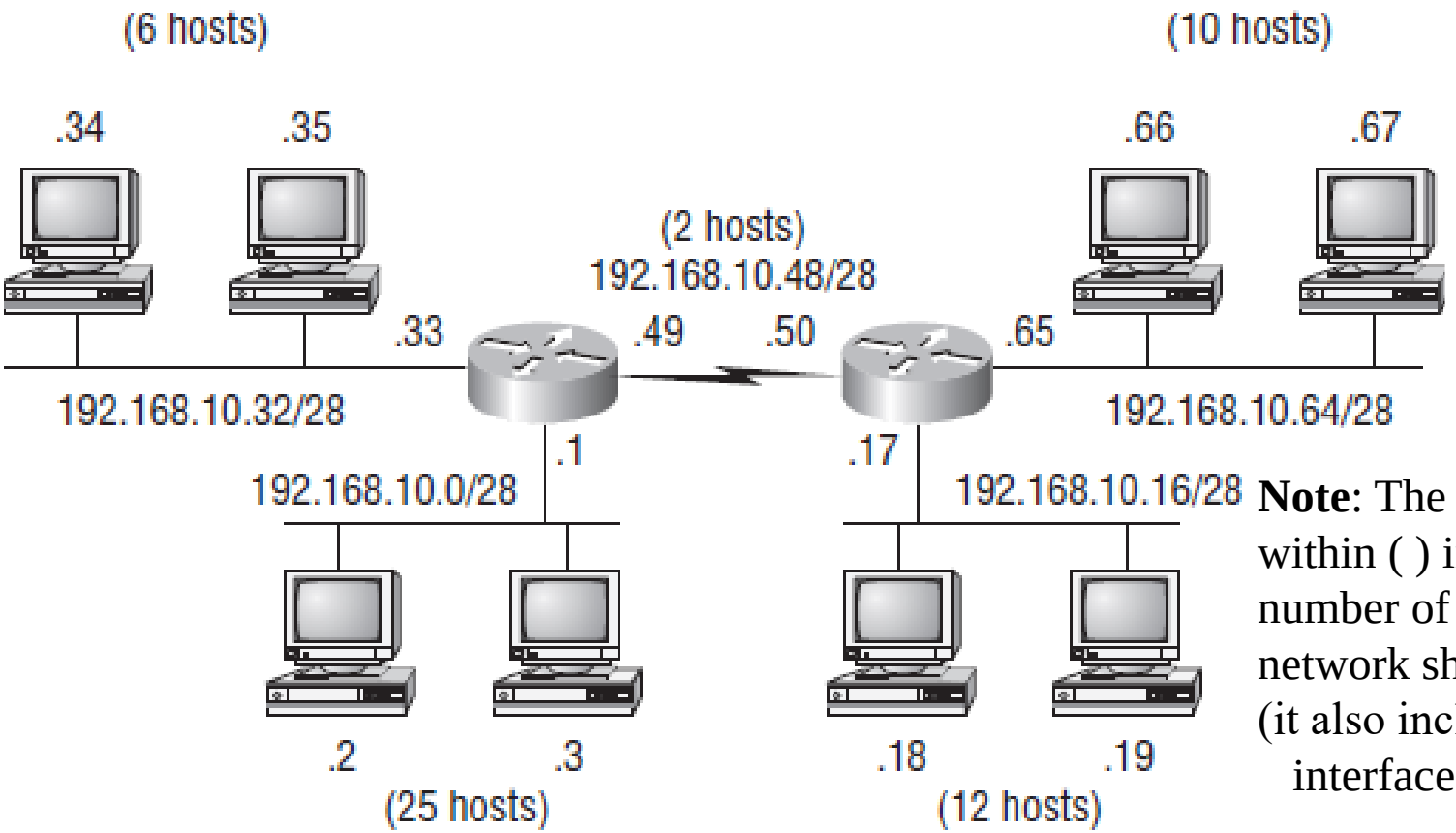
1. No. of Networks: 5

2. Class of the NW: Class C

3. Subnet mask of the NW: 255.255.255.240

4. Are all the networks having the same subnet mask or different? The same

Example 0 Network … contd.

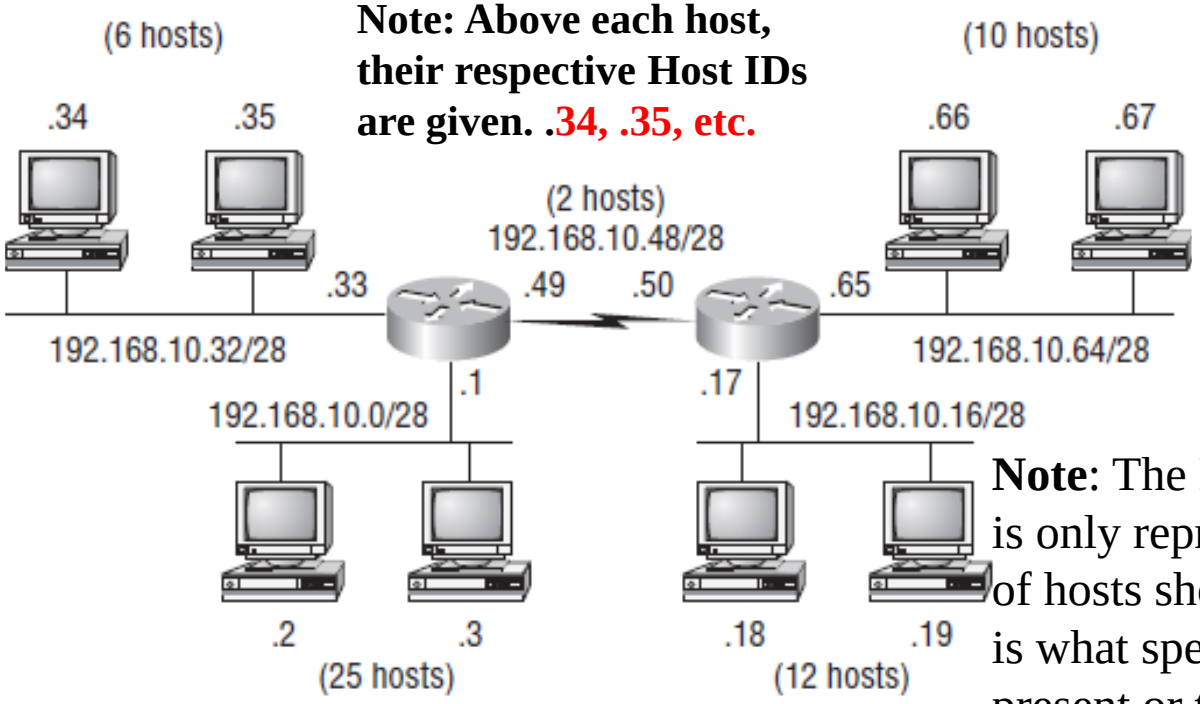


Note: The no. of hosts given within ( ) indicate the number of hosts that each network should support. (it also includes router's interface too)

5. Do you notice any problem with this network? Can the number of hosts have mentioned be supported by every network?

ANS: The network which is supposed to have 25 hosts, will not be able to support 25 hosts Because the subnet mask is /28, which reserves only four bits for host ID, and thus max 14 hosts (2^4 - 2) can be connected.

Example 0 Network … contd.



Note: Above each host, their respective Host IDs are given. .34, .35, etc.

6. Is the IP address space utilized efficiently here or wasted on any of the Networks? Justify your answer.

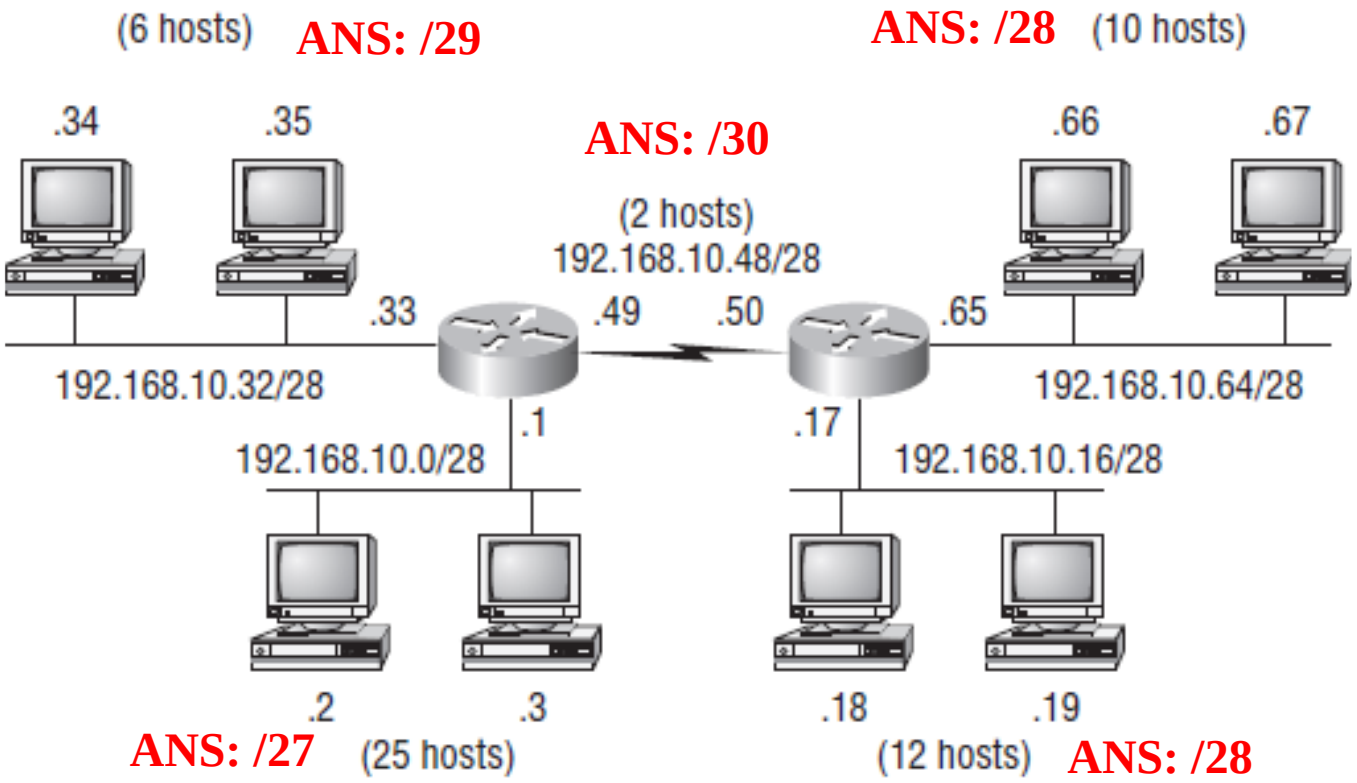
Note: The Number of hosts connected is only representative. The number of hosts shown within parenthesis ( ) is what specifying the number of hosts present or to be connected to each network.

Ans: The wireless link which happens to be a WAN link shows that there are going to be maximum two hosts, which are the two interfaces of the routers on each side. But the subnet mask of that network is /28, which means that it can have maximum of 14 hosts, whereas only two are going to be connected. So, 12 IP addresses are wasted!!!

Apart from the wireless link, the other network in the top having only 6 hosts, wastes the remaining address space, because there can be maximum of 14 hosts on it too.

Example 1 Network: Solution

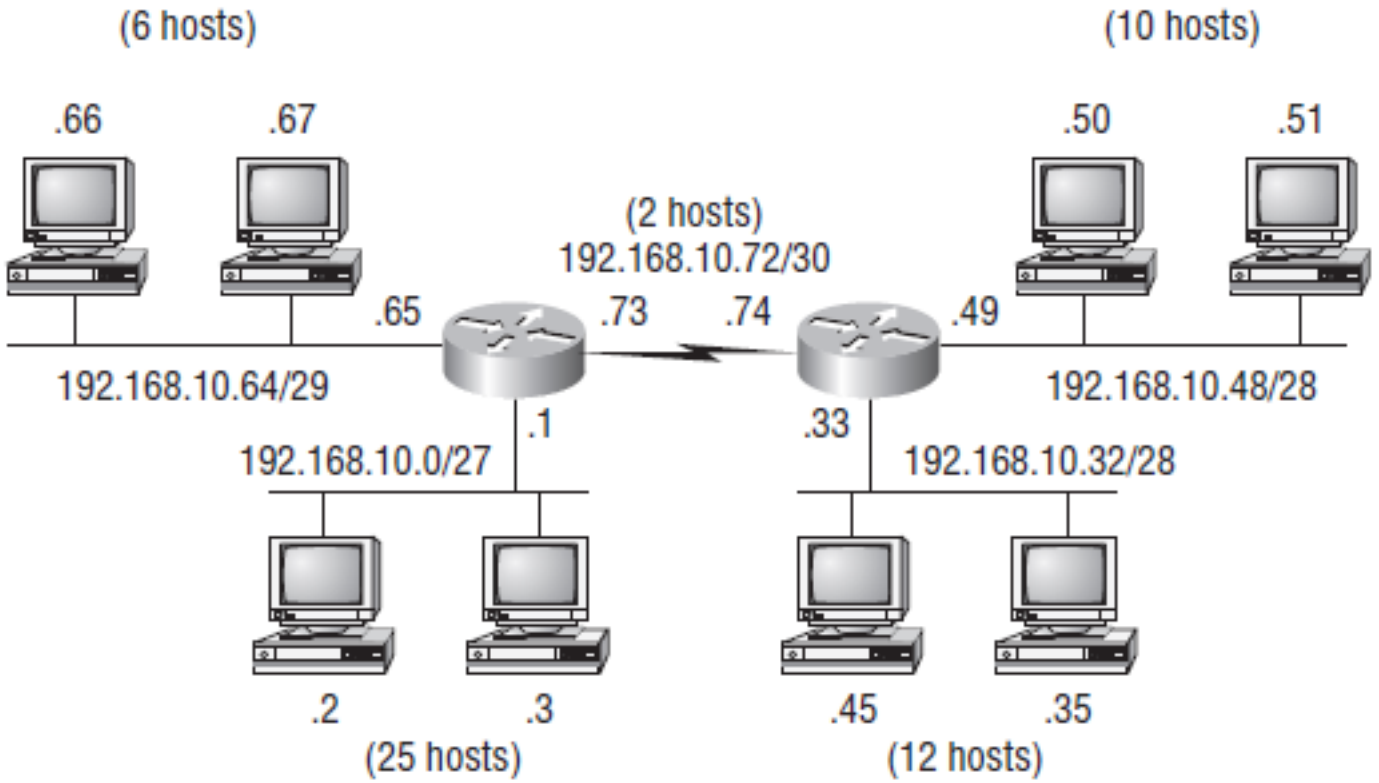
This is called VLSM



Give a suitable subnet mask in CIDR notation for each of the networks here, which will enable the no. of hosts that are shown within () to be on the network. Take care of not wasting the address space.

- What is the best way to save the IP address space?
- If you are free to choose different subnet masks for each of the networks, you can choose the subnet masks according to the no. of hosts going to be on them, there by saving the IP address space.

Example 2 Network with VLSM



- **VLSM** is a method of taking one network and creating many sub-networks using **subnet masks of different lengths**
- As the name suggests, with **VLSMs** we can have **different subnet masks** for **different router interfaces**.

Variable Length Subnet Masking: Explained

- **VLSM** allows division of address space based on the size of networks

1. Start with the network which requires the most addresses
2. Create a subnet mask (as per CIDR scheme) for the largest network, in our Example1, it is /27.
3. Subnet the network as needed, to provide address space required for other networks or subnets
4. Be logical, start at the beginning or end of the available address space
5. Addresses must be contiguous to enable route summarization

- Having variable subnet masks warrants that for each of the networks, the corresponding subnet mask (CIDR value) also transmitted while setting up routes, using routing protocols.
  - This will be covered in more detail, while discussing routing protocols
  - Remember that as in classful addressing, routers cannot deduce the subnet masks from the given IP addresses, so they need to be sent along with each IP address.

Benefits of VLSM

- Subnetting lets you efficiently allocate addresses by taking one large broadcast domain and breaking it up into smaller, more manageable broadcast domains.
- VLSMs let you more efficiently allocate IP addresses by adding multiple layers of the address hierarchy.
- The benefits of **route summarization** include smaller routing tables and the ability to isolate topology changes
  - **Route summarization**, also called **route aggregation**, is a method of minimizing the number of routing tables in an IP (Internet Protocol) network
  - This will be explained when Routing protocols are discussed

VLSM Implementation

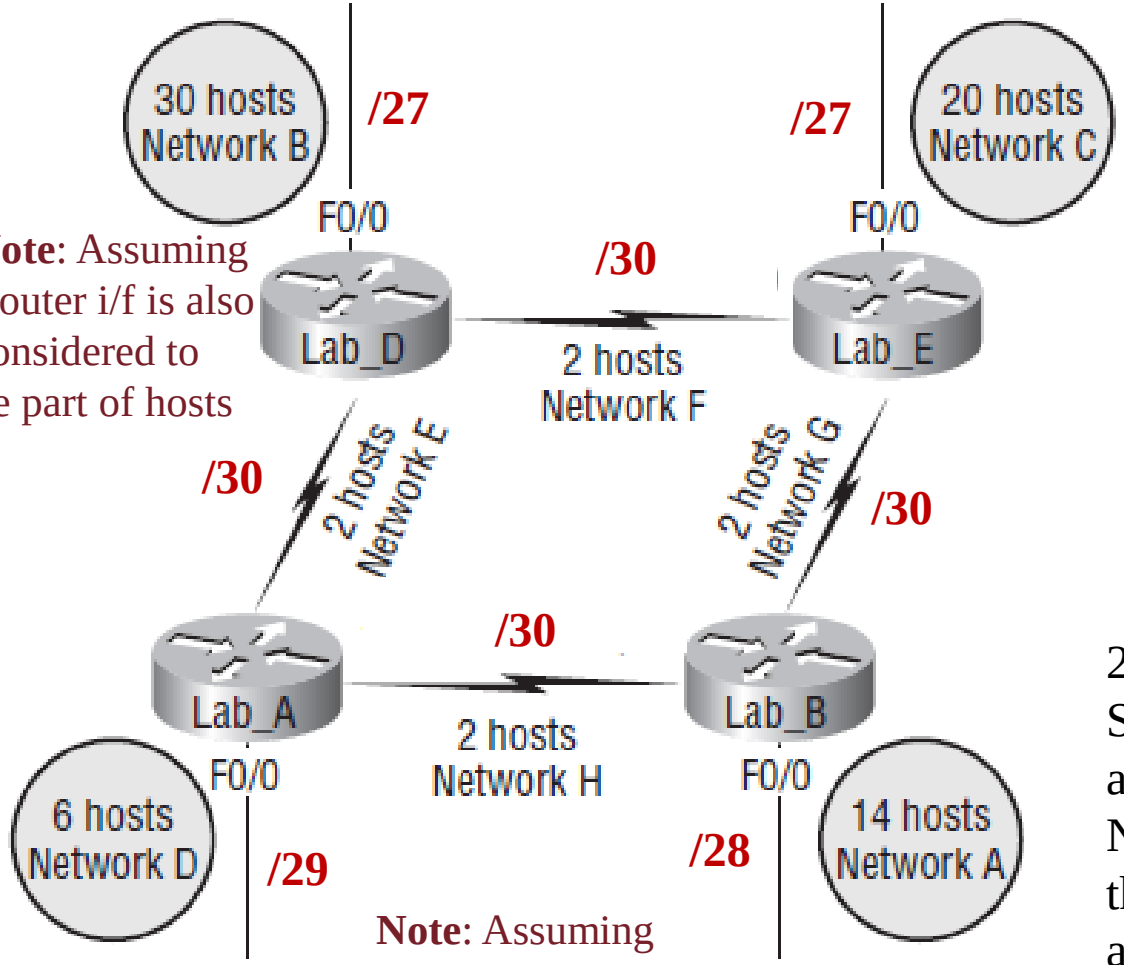
Block Sizes – No. of Hosts

- Assume you are given a Class C network 192.168.10.0 address
- It has a block of 254 valid host addresses ($2^8 - 2$) in total
- Give the possible subnets that can be created along with their respective valid hosts and block sizes for each subnet masks below

Prefix	Mask (Give the last Byte value)	Hosts	Block Size (Host ID part)
/25	128	126	128
/26	192	62	64
/27	224	30	32
/28	240	14	16
/29	248	6	8
/30	252	2	4

Note: **/24** is not shown here because it is the **default net mask,** without any subnetting for a Class C network.

Example 1: VLSM Design
(Identify the optimal subnet masks for each network)



Note: Assuming Router i/f is also considered to be part of hosts

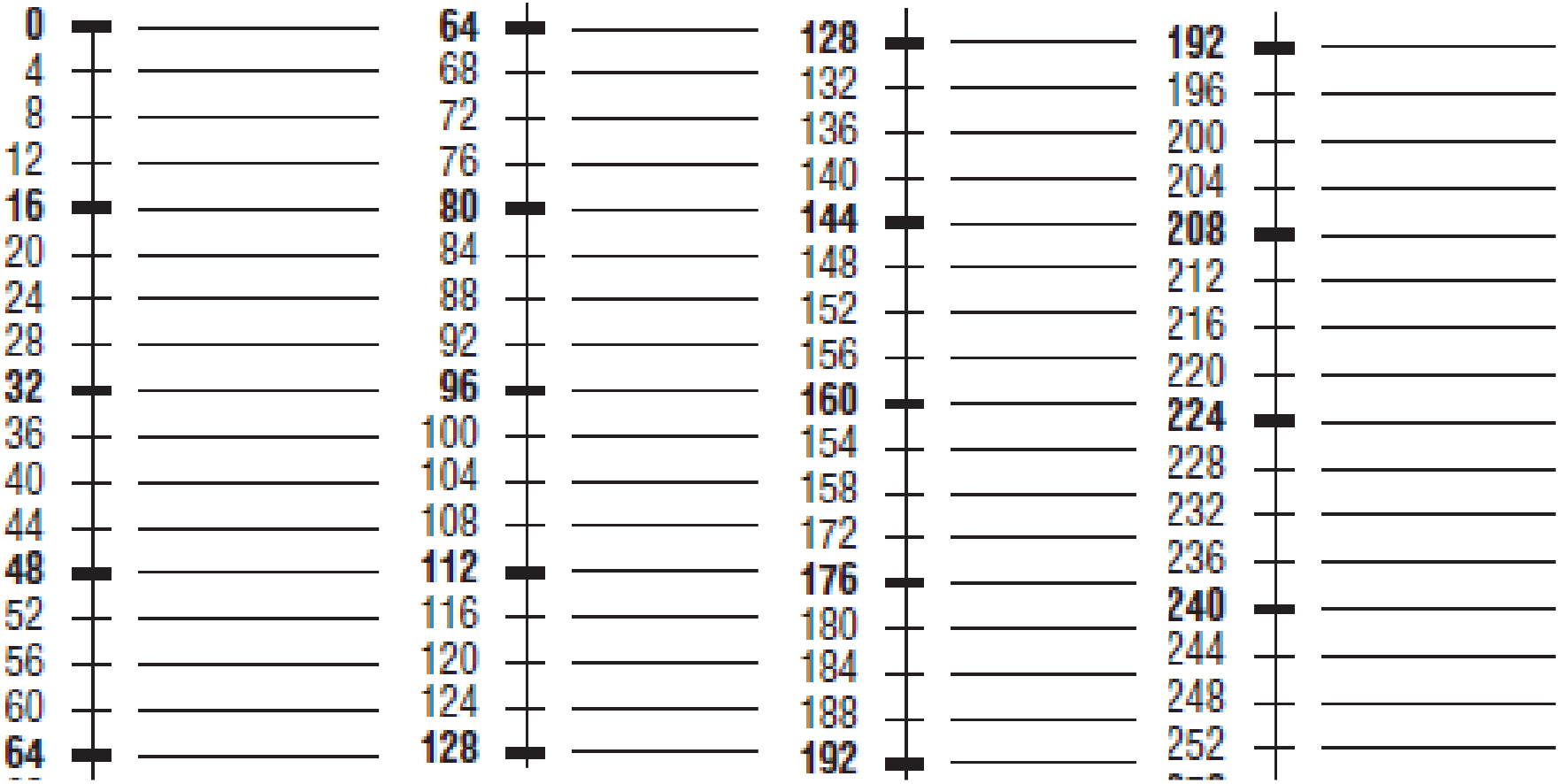
Note: Assuming Router i/f is also considered to be part of hosts

Note: Based on the no. of hosts need to be supported on each of the networks, give the subnet masks that need to be chosen.

1. Remember that the subnet mask that we need to choose are the next higher power of two, then the maximum no. of hosts on each network.

2. The next step is to choose the Subnet IDs of each block of addresses identified for each Network. We need to make sure that consecutive address blocks are chosen, without any gaps between them. It helps in efficient routing.

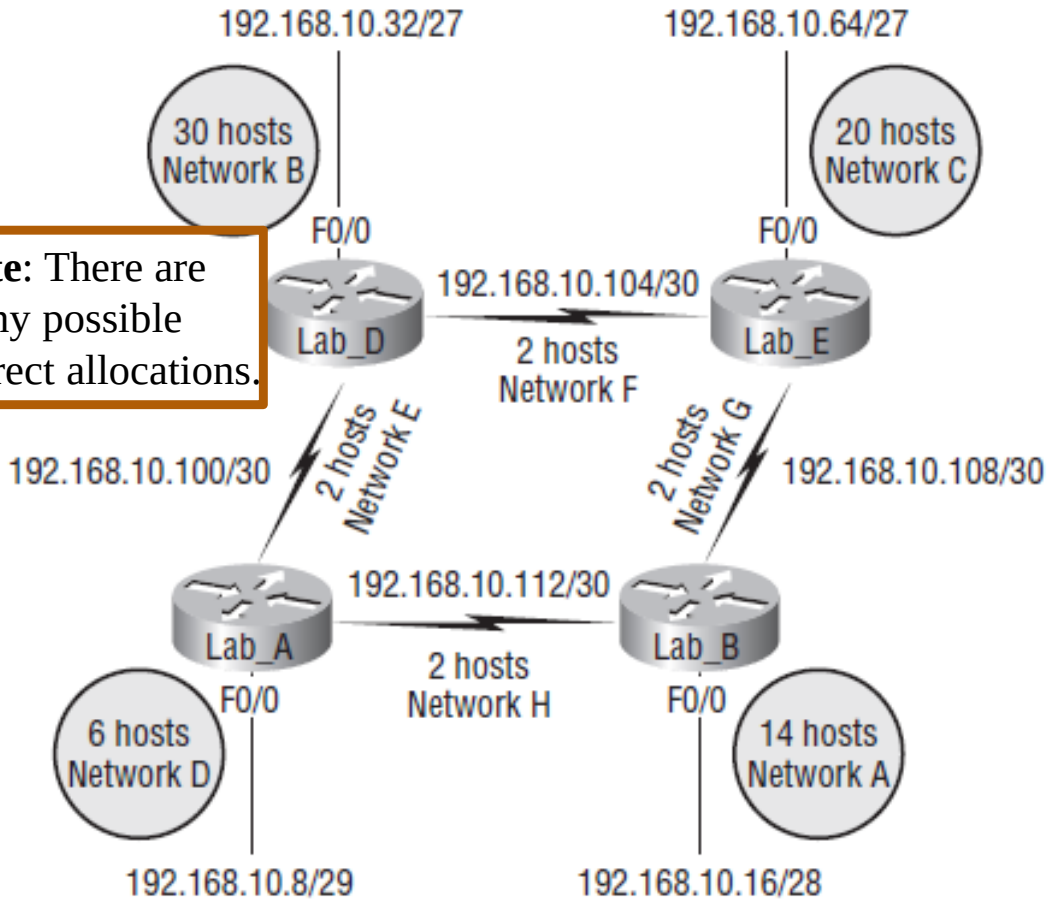
Class C Host ID Range (last byte)



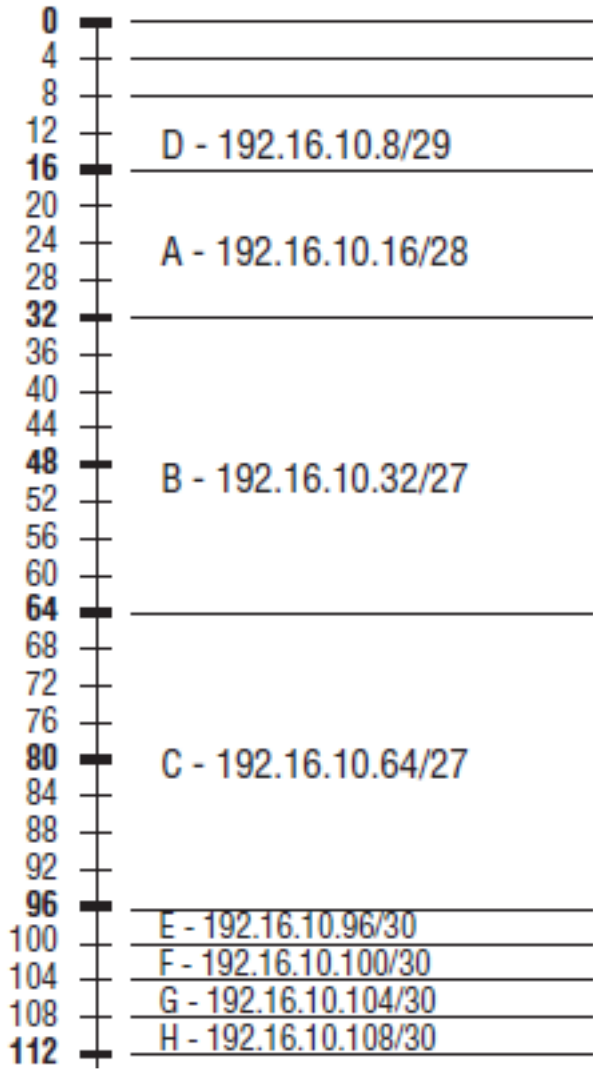
Each line shows a block of four consecutive IP addresses, for a given Class C address block

The first 24 bits or 3 bytes, Network ID part of the IP address is the same for each of these host addresses

One Possible Allocation of addresses
(by choosing the subnet IDs for each network)



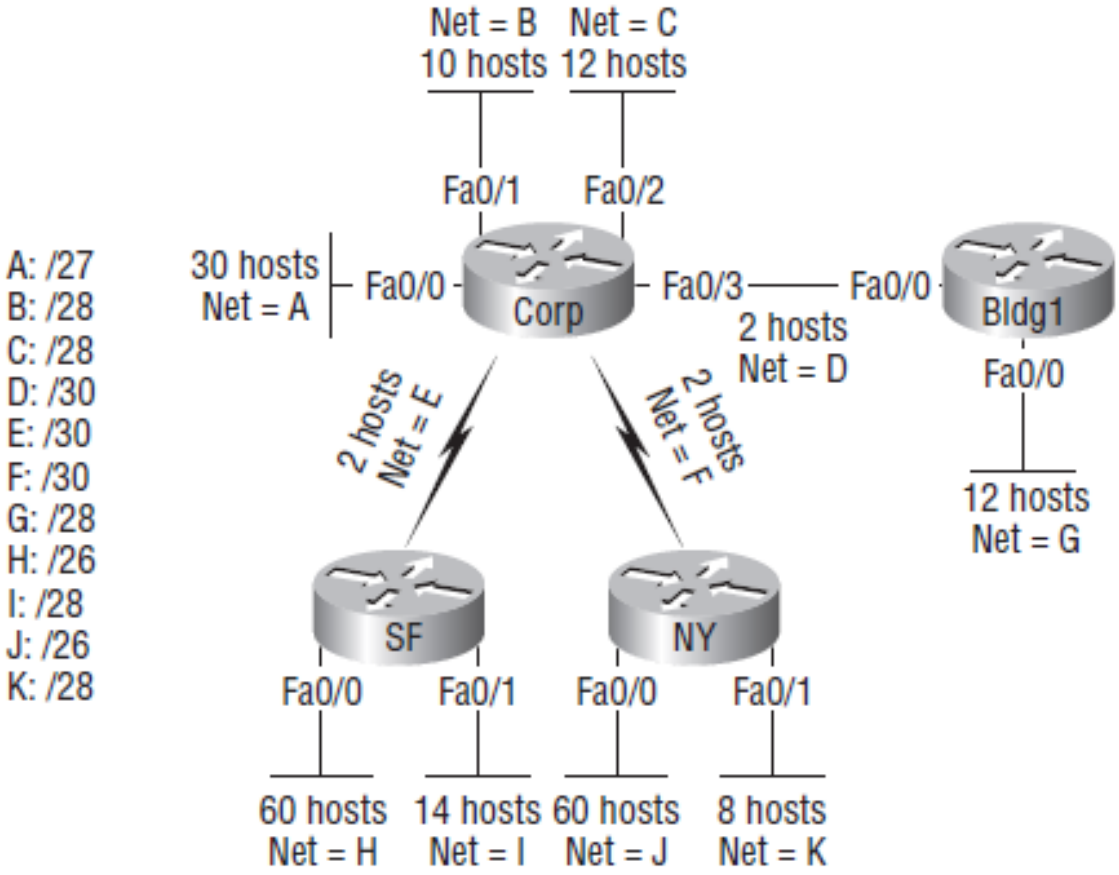
Note: There are many possible correct allocations.



Caution: Choose the subnet masks such that there are no duplicate assignments of IP addresses to multiple hosts on different subnets. Make sure that there is no overlap of addresses

Example 2: VLSM Design: Homework

FIGURE 3.8 VLSM network example 2



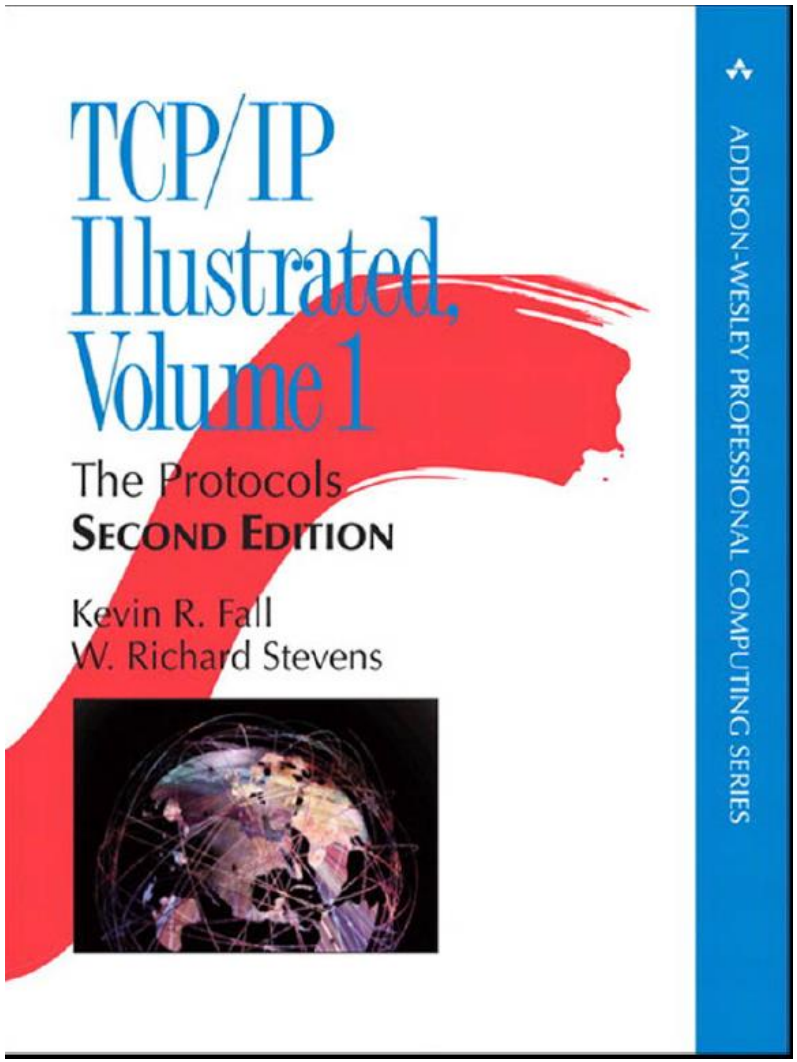
- **Ref3: CCNA book: Page 144**

Summary

- Example 0 Network and need for VLSM
- VLSM Explained
- Benefits of VLSM
- VLSM Design
  - Standard Block Sizes (no. of hosts)
  - VLSM Table
- Example 1: VLSM Implementation
- Example 2: VLSM Implementation
  - Understand it by reading the CCNA book - Homework

References

Ref 1



Ref 2

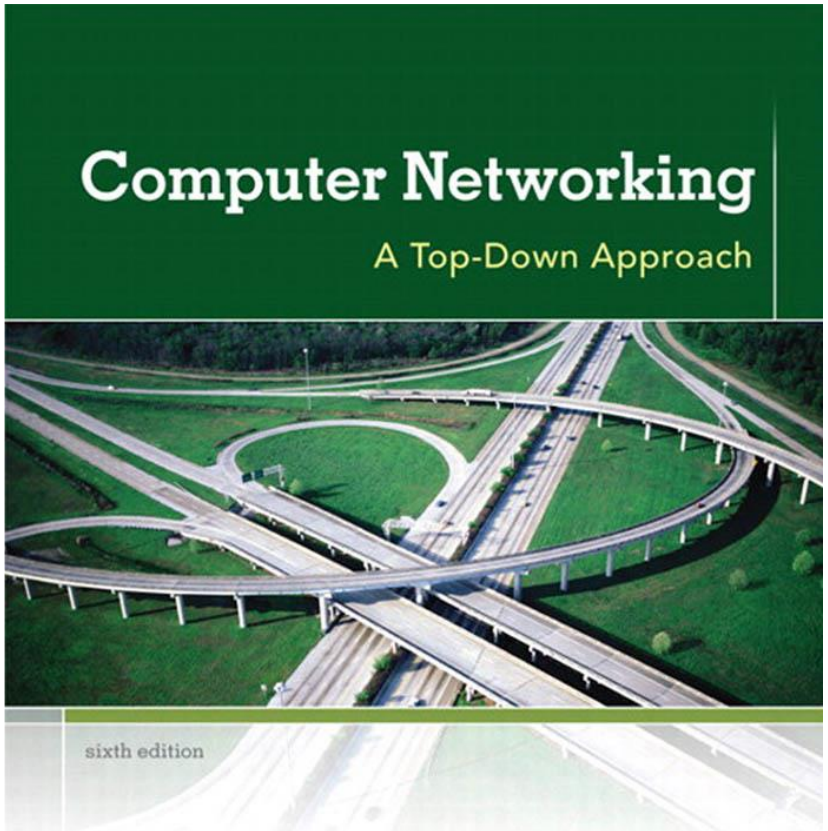
TCP Congestion Control: A Systems Approach

TCP Congestion Control: A Systems Approach

Peterson, Brakmo, and Davie

References

Ref 3



Ref 4