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VLSM and CIDR

Routing Protocols and Concepts – Chapter 6

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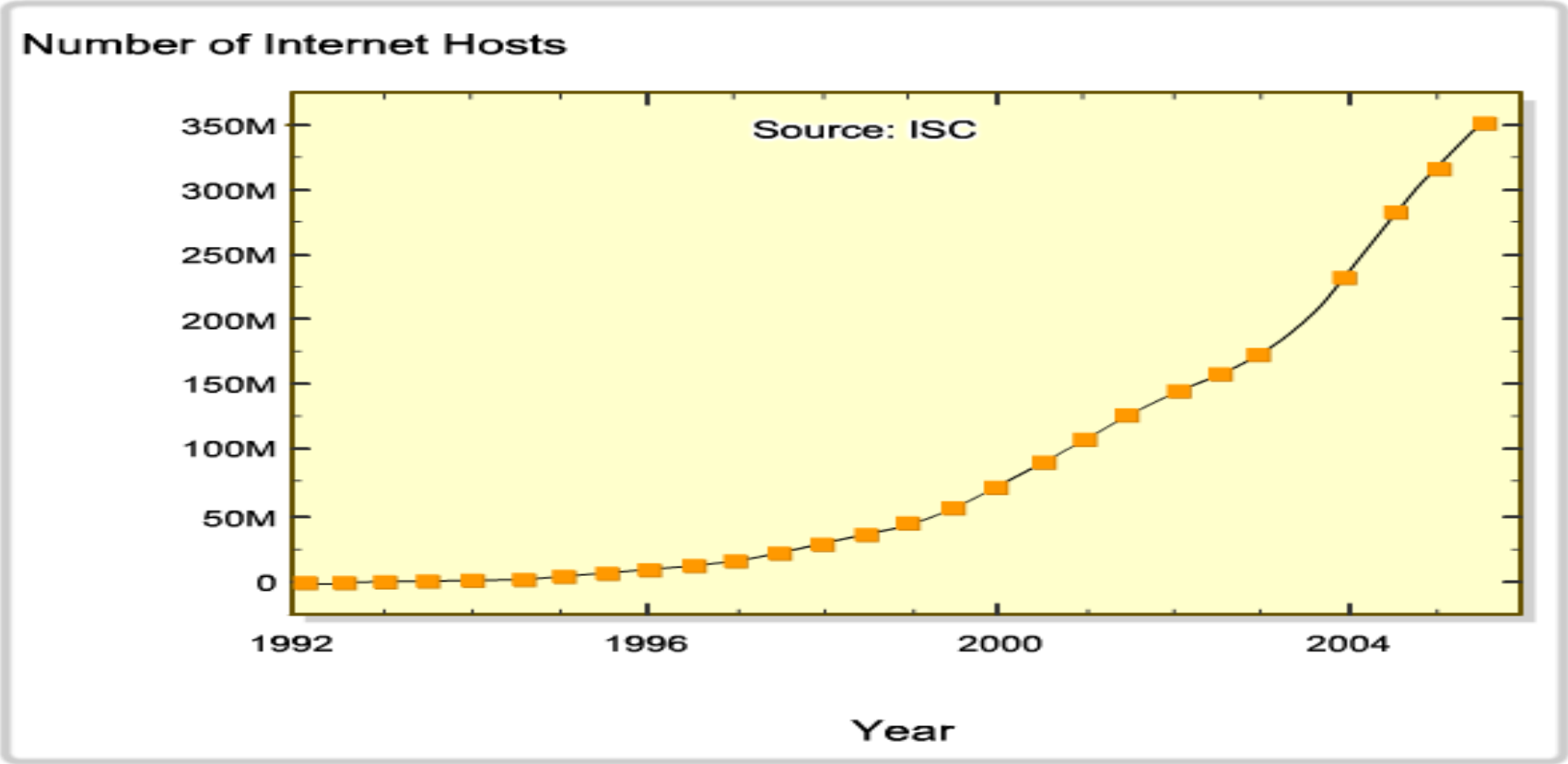
6..0.1 Introduction

In this chapter, you will learn to:

- Compare and contrast classful and classless IP addressing.
- Review VLSM and explain the benefits of classless IP addressing.
- Describe the role of the Classless Inter-Domain Routing (CIDR) standard in making efficient use of scarce IPv4 addresses.

6.1.1 Classful IP Addressing



Classful IP addressing

As of January 2007, there are over 433 million hosts on internet

Initiatives to conserve IPv4 address space include:

- -VLSM & CIDR notation (1993, RFC 1519)
- -Network Address Translation (1994, RFC 1631)
- -Private Addressing (1996, RFC 1918

6.1.1 Classful IP Addressing

HIGH ORDER BITS

Class	High Order Bits	Start	End
Class A	0	0.0.0.0	127.255.255.255
Class B	10	128.0.0.0	191.255.255.255
Class C	110	192.0.0.0	223.255.255.255
Multicast	1110	224.0.0.0	239.255.255.255
Experimental	1111	240.0.0.0	255.255.255.255

6.1.1 Classful IP Addressing

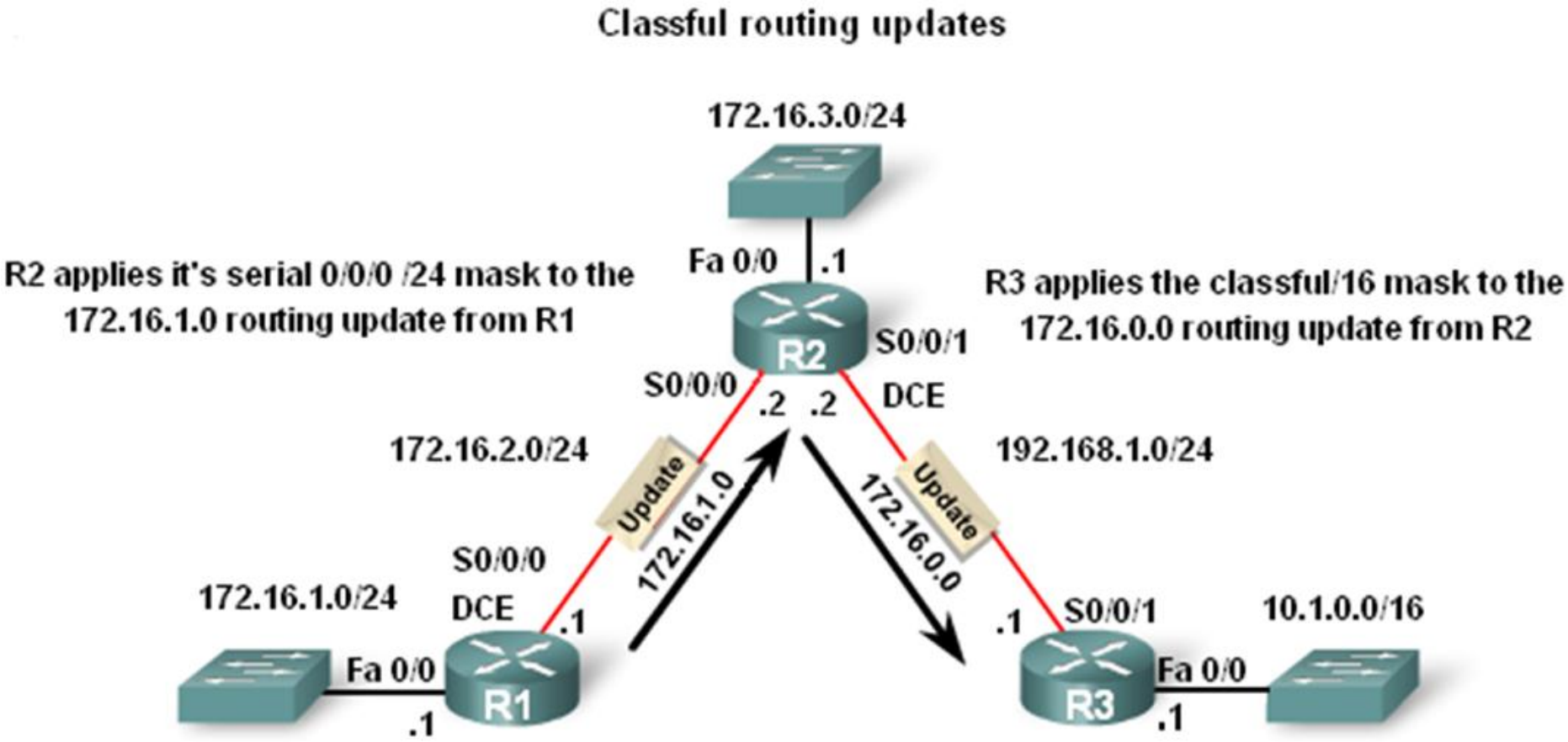
Subnet Mask based on Class

	1st Octet	2nd Octet	3rd Octet	4th Octet	Subnet Mask
Class A	Network	Host	Host	Host	255.0.0.0 or /8
Class B	Network	Network	Host	Host	255.255.0.0 or /16
Class C	Network	Network	Network	Host	255.255.255.0 or /24

Number of Networks and Hosts per Network for Each Class

Address class	First Octet Range	Number of Possible Networks	Number of Host per Network
Class A	0 to 127	128 (2 are reserved)	16,777,214
Class B	128 to 191	16,384	65,534
Class C	192 to 223	2,097,152	254

6.1.2 Classful IP Addressing



Classful Routing Updates

-Recall that classful routing protocols (i.e. RIPv1) do not send subnet masks in their routing updates The reason is that the Subnet mask is directly related to the network address

6.1.3 Classless IP Addressing

Classless Inter-domain Routing (CIDR – RFC 1517)

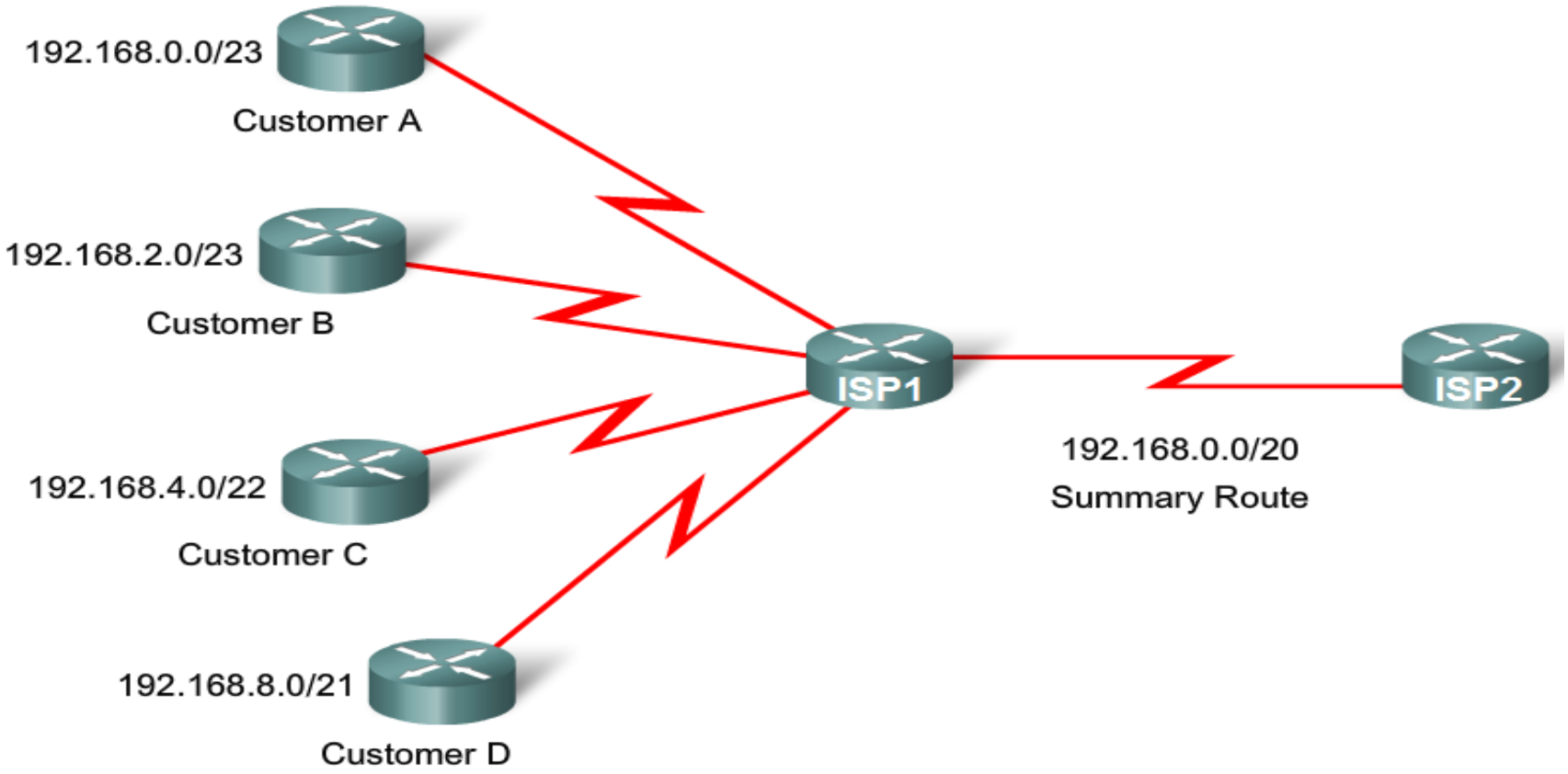
Advantage of CIDR :

- -More efficient use of IPv4 address
- -Route summarization
  - Requires subnet mask to be included in routing update because address class is meaningless

Recall purpose of a subnet mask:

- -To determine the network and host portion of an IP address

6.1.3 Classless IP Addressing



Classless IP Addressing

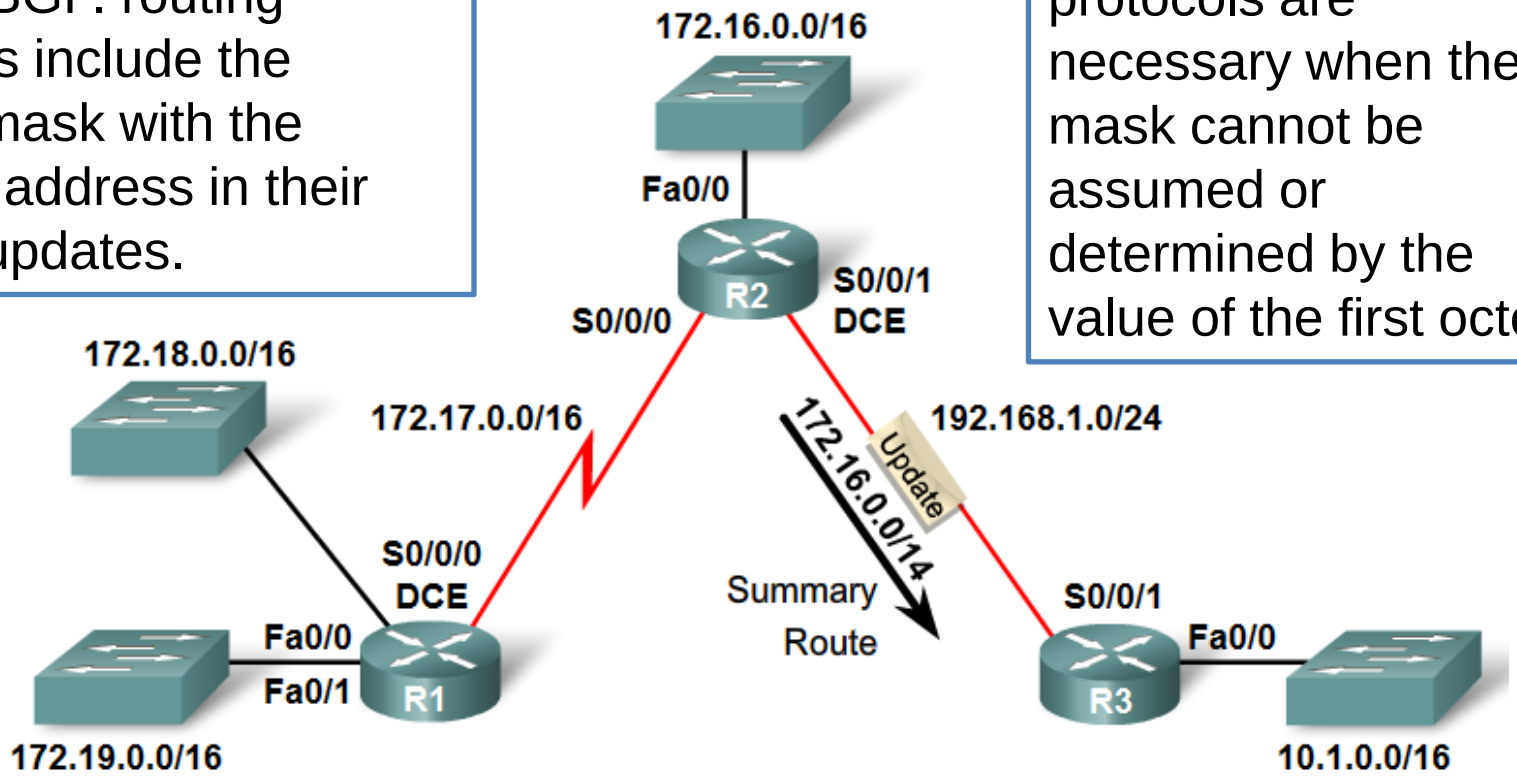
CIDR & Route Summarization

- -Variable Length Subnet Masking (VLSM)
- -Allows a subnet to be further sub-netted according to individual needs
- -Prefix Aggregation a.k.a. Route Summarization
- -CIDR allows for routes to be summarized as a single route

6.1.4 Classless Routing Protocol

RIPv2, EIGRP, OSPF, IS-IS, and BGP. routing protocols include the subnet mask with the network address in their routing updates.

Classless routing protocols are necessary when the mask cannot be assumed or determined by the value of the first octet

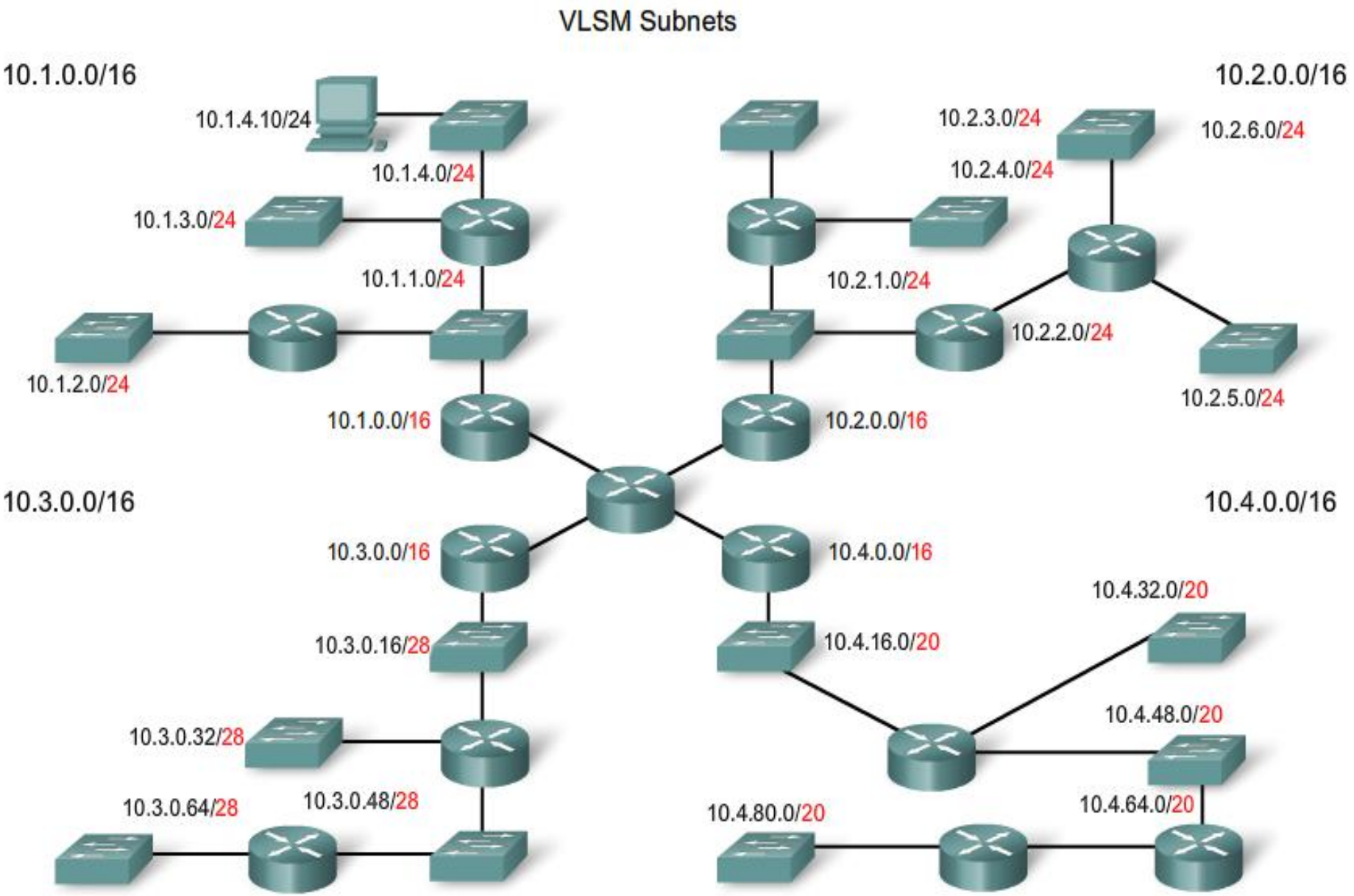


Classless Routing Protocol

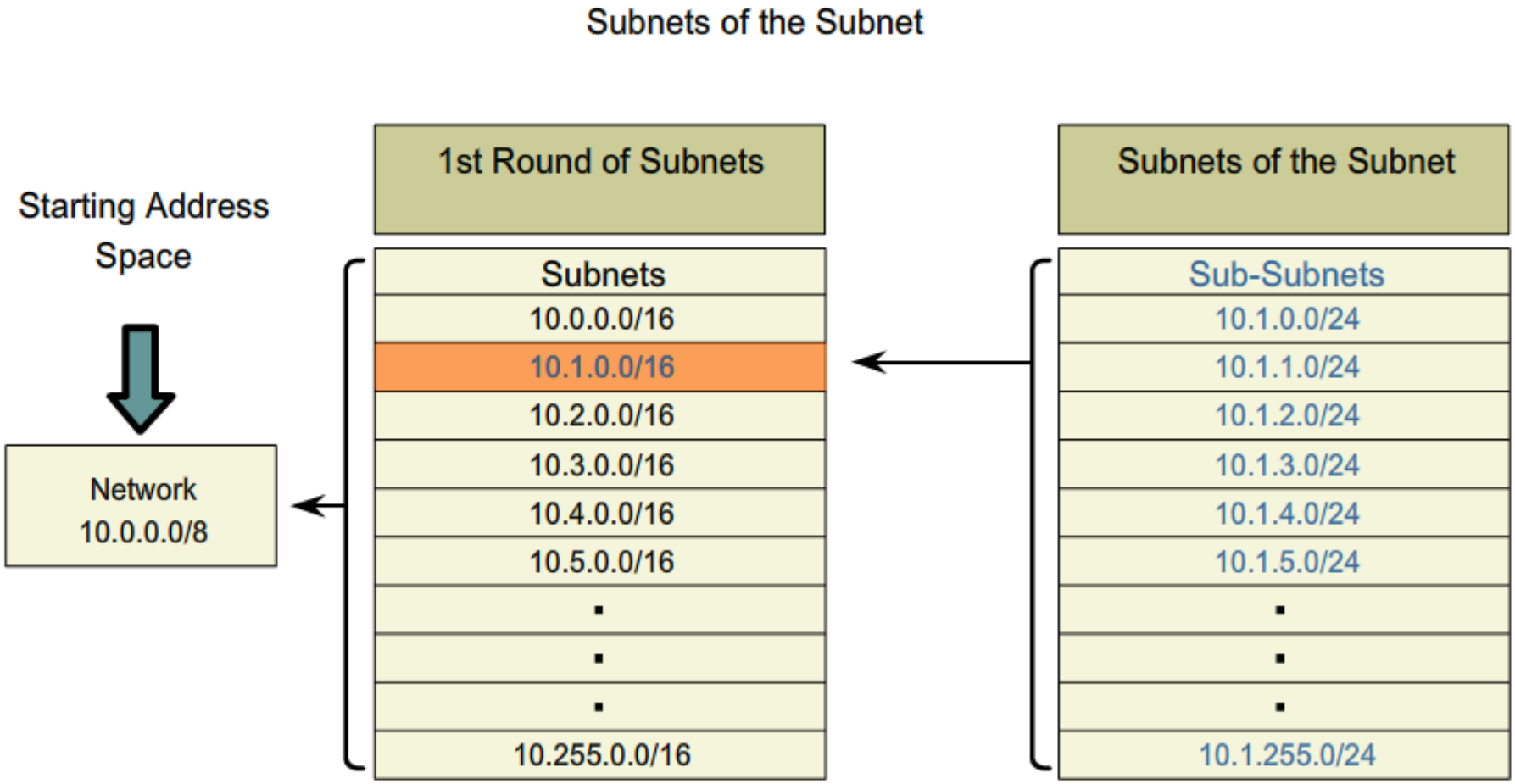
Characteristics of classless routing protocols:

- -Routing updates include the subnet mask
- -Supports VLSM
- -Supports Route Summarization

6.2.1 VLSM in Action

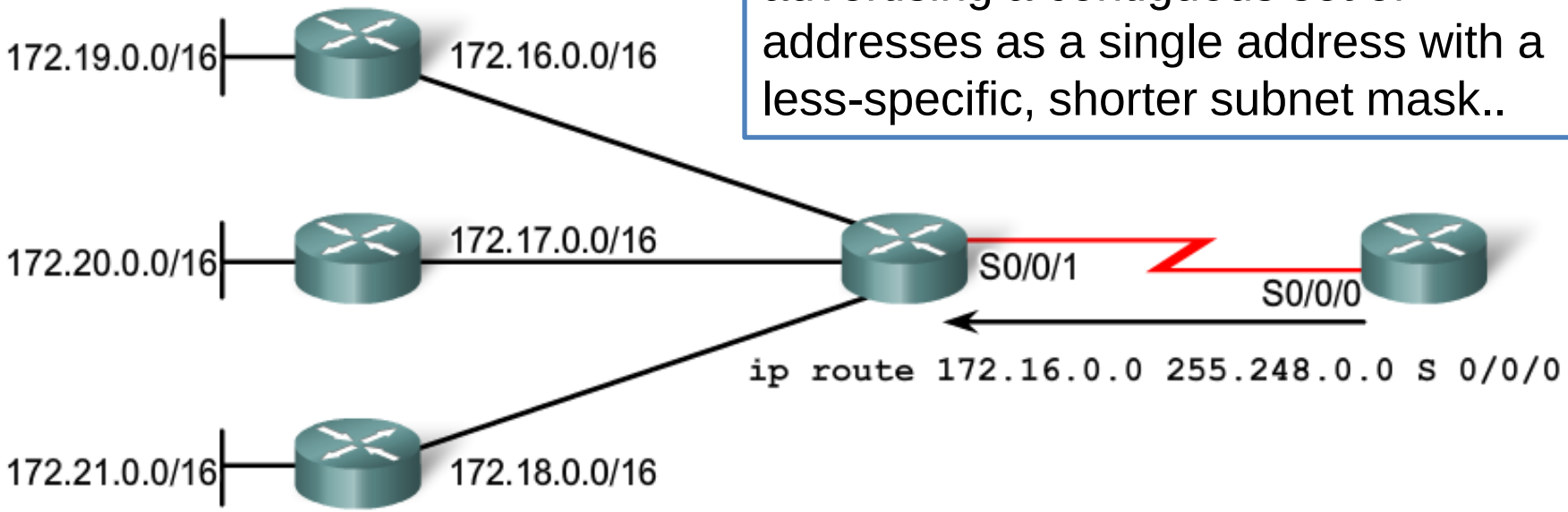


6.2.2 VLSM and IP Addresses



6.3.1 Route Summarization

Route summarization also known as route aggregation, is the process of advertising a contiguous set of addresses as a single address with a less-specific, shorter subnet mask..



Route summarization done by CIDR

- -Routes are summarized with masks that are less than that of the default classful mask
- -Example:

  172.16.0.0 / 13 is the summarized route for the

  172.16.0.0 / 16 to 172.23.0.0 / 16 classful networks

Remember that CIDR is a form of route summarization and is synonymous with the term supernetting

6.3.2 Calculating Route Summarization

Step 1: List networks in binary format.

Step 2: Count the number of left-most matching bits to determine the mask.

14 matching bits, /14 or 255.252.0.0

Step 3: Copy the matching bits and add zero bits to determine the network address.

Steps to calculate a route summary

1. -List networks in binary format
2. -Count number of left most matching bits to determine summary route's mask
3. -Copy the matching bits and add zero bits to determine the summarized network address

6.4.1 Basic VLSM Calculation and Address Design

6.4.1 BASIC VLSM CALCULATION AND ADDRESSING DESIGN

Hands-on Lab:
Basic VLSM Calculation and Addressing Design

In this activity, you will use the network address 192.168.1.0/24 to subnet and provide the IP addressing for a given topology. VLSM will be used so that the addressing requirements can be met using the 192.168.1.0/24 network.

Packet Tracer Exploration:
Basic VLSM Calculation and Addressing Design

You can use Packet Tracer Activity 6.4.1 to complete this activity. A summary of the instructions is provided within the activity, but you should use the Activity PDF on the previous page for more details.

6.4.2 Challenge VLSM Calculation and Address Design

6.4.2 CHALLENGE VLSM CALCULATION AND ADDRESSING DESIGN

Hands-on Lab:
Challenge VLSM Calculation and Addressing Design

In this activity, you will use the network address 172.16.0.0/16 to subnet and provide the IP addressing for a given topology. VLSM will be used so that the addressing requirements can be met using the 172.16.0.0/16 network.

Packet Tracer Exploration:
Challenge VLSM Calculation and Addressing Design

You can use Packet Tracer Activity 6.4.2 to complete this activity. A summary of the instructions is provided within the activity, but you should use the Activity PDF on the previous page for more details.

6.4.3 Troubleshooting a VLSM Design

6.4.3 TROUBLESHOOTING A VLSM ADDRSSING DESIGN

Hands-on Lab:
Troubleshooting a VLSM Addressing Design

In this activity, the network address 172.16.128.0/17 was used to provide the IP addressing for a network. VLSM has been used to subnet the address space incorrectly. You will need to troubleshoot the addressing that was assigned to each subnet to determine where errors are present and determine the correct addressing assignments where needed.

Packet Tracer Exploration:
Troubleshooting a VLSM Addressing Design

You can use Packet Tracer Activity 6.4.3 to complete this activity. A summary of the instructions is provided within the activity, but you should use the Activity PDF on the previous page for more details.

6.4.4 Basic Route Summarization

6.4.4 BASIC ROUTE SUMMARIZATION

Hands-on Lab:
Basic Route Summarization

n this activity, you are given a network with subnetting and address assignments already completed. Your task is to determine summarized routes that can be used to reduce the number of entries in routing tables.

Packet Tracer Exploration:
Basic Route Summarization

You can use Packet Tracer Activity 6.4.4 to complete this activity. A summary of the instructions is provided within the activity, but you should use the Activity PDF on the previous page for more details.

6.4.5 Challenge Route Summarization

6.4.5 CHALLENGE ROUTE SUMMARIZATION

Hands-on Lab:
Challenge Route Summarization

In this activity, you are given a network with subnetting and address assignments already completed. Your task is to determine summarized routes that can be used to reduce the number of entries in routing tables.

Packet Tracer Exploration:
Challenge Route Summarization

You can use Packet Tracer Activity 6.4.5 to complete this activity. A summary of the instructions is provided within the activity, but you should use the Activity PDF on the previous page for more details.

6.4.6 TROUBLESHOOTING ROUTE SUMMARIZATION

Hands-on Lab:
Troubleshooting Route Summarization

In this activity, the LAN IP addressing is already completed for the network. VLSM was used to subnet the address space. The summary routes are incorrect. You will need to troubleshoot the summary routes that have been assigned to determine where errors are present and determine the correct summary routes.

Packet Tracer Exploration:
Troubleshooting Route Summarization

You can use Packet Tracer Activity 6.4.6 to complete this activity. A summary of the instructions is provided within the activity, but you should use the Activity PDF on the previous page for more details.

6.5.1 Summary and Review

Classful IP addressing

- IPv4 addresses have 2 parts:
  - -Network portion found on left side of an IP address
  - -Host portion found on right side of an IP address

- Class A, B, & C addresses were designed to provide IP addresses for different sized organizations

- The class of an IP address is determined by the decimal value found in the 1st octet

- IP addresses are running out so the use of Classless Inter Domain Routing (CIDR) and Variable Length Subnet Mask (VLSM) are used to try and conserve address space

- Classful Routing Updates
  - Subnet masks are not sent in routing updates

6.5.1 Summary and Review

- **Classless IP addressing (CIDR)**
  - Benefit of classless IP addressing
    - Can create additional network addresses using a subnet mask that fits your needs
  - Uses Classless Interdomain Routing (CIDR)
  - Uses IP addresses more efficiently through use of VLSM
    - -VLSM is the process of subnetting a subnet
  - Allows for route summarization
    - -Route summarization is representing multiple contiguous routes with a single route
  - **Classless Routing Updates**
    - Subnet masks are included in updates

6.5.1 Summary and Review

In this chapter, you have learned to:

- Compare and contrast classful and classless IP addressing.
- Review VLSM and explain the benefits of classless IP addressing.
- Describe the role of the Classless Inter-Domain Routing (CIDR) standard in making efficient use of scarce IPv4 addresses.

6.5.1 Summary and Review

6.5.1 SUMMARY AND REVIEW

Packet Tracer Exploration:
Ch6 - Packet Tracer Skills Integration Challenge

The Packet Tracer Skills Integration Challenge Activity for this chapter is a moderately complex VLSM design scenario. You will create an addressing scheme based on requirements specified in the instructions, then you will build the network and configure the routers. Because you have not yet learned classful routing protocols, you will be shown two commands that will make your RIP network converge in a classless manner. Finally, you configure a summary route.