IP Addresses: Classful Addressing

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- INTRODUCTION
- CLASSFUL ADDRESSING
  - Different Network Classes
  - Subnetting
- Classless Addressing
  - Supernetting
  - CIDR (classless Interdomain Routing)

4.1

INTRODUCTION

What is an IP Address?

An IP address is a 32-bit address.

Note

The IP addresses are unique.

Address Space

Address space rule

The address space in a protocol That uses N-bits to define an Address is:

$$2^N$$

IPv4 address space

The address space of IPv4 is

2^{32}

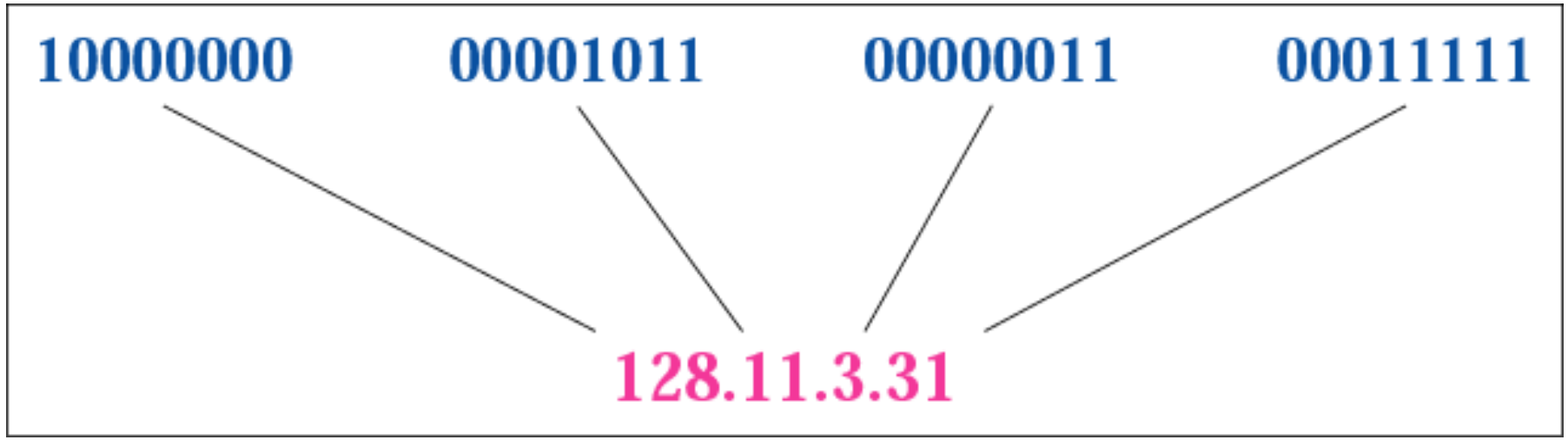
or

4,294,967,296.

Binary Notation

01110101 10010101 00011101 11101010

Dotted-decimal notation



Hexadecimal Notation

0111 0101 1001 0101 0001 1101 1110 1010

75 95 1D EA

0x75951DEA

Example 1

Change the following IP address from binary notation to dotted-decimal notation.

10000001 00001011 00001011 11101111

Solution

Example 1

Change the following IP address from binary notation to dotted-decimal notation.

10000001 00001011 00001011 11101111

Solution

129.11.11.239

Example 2

Change the following IP address from dotted-decimal notation to binary notation:

111.56.45.78

Solution

Example 2

Change the following IP address from dotted-decimal notation to binary notation:

111.56.45.78

Solution

01101111 00111000 00101101 01001110

Example 3

Find the error in the following IP Address
111.56.045.78

Solution

Example 3

Find the error in the following IP Address
111.56.045.78

Solution

There are no leading zeroes in
Dotted-decimal notation (045)

Example 3 (continued)

Find the error in the following IP Address
75.45.301.14

Solution

Example 3 (continued)

Find the error in the following IP Address
75.45.301.14

Solution

In decimal notation each number <= 255
301 is out of the range

Example 4

Change the following binary IP address Hexadecimal notation

10000001 00001011 00001011 11101111

Solution

Example 4

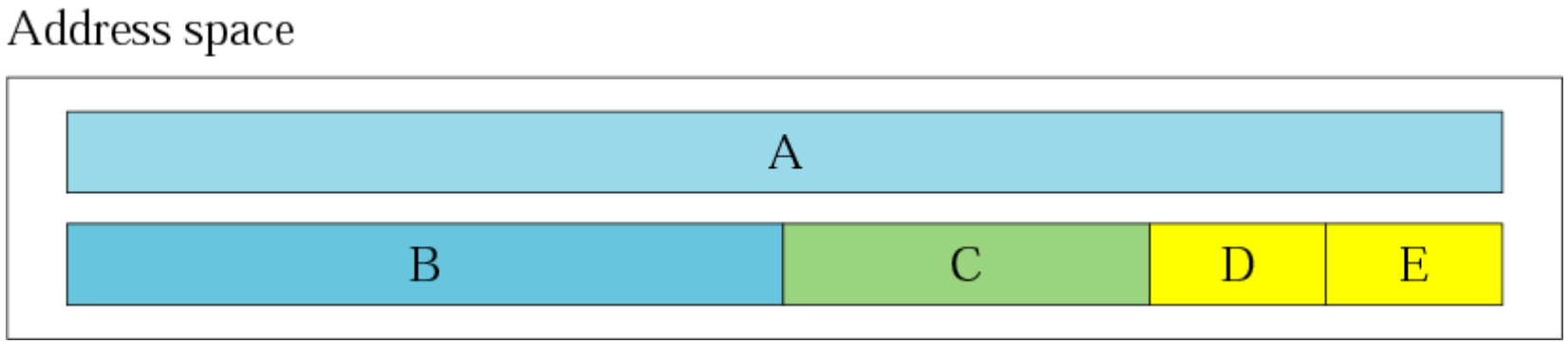
Change the following binary IP address
Hexadecimal notation
10000001 00001011 00001011 11101111

Solution

0X810B0BEF or 810B0BEF16

CLASSFUL ADDRESSING

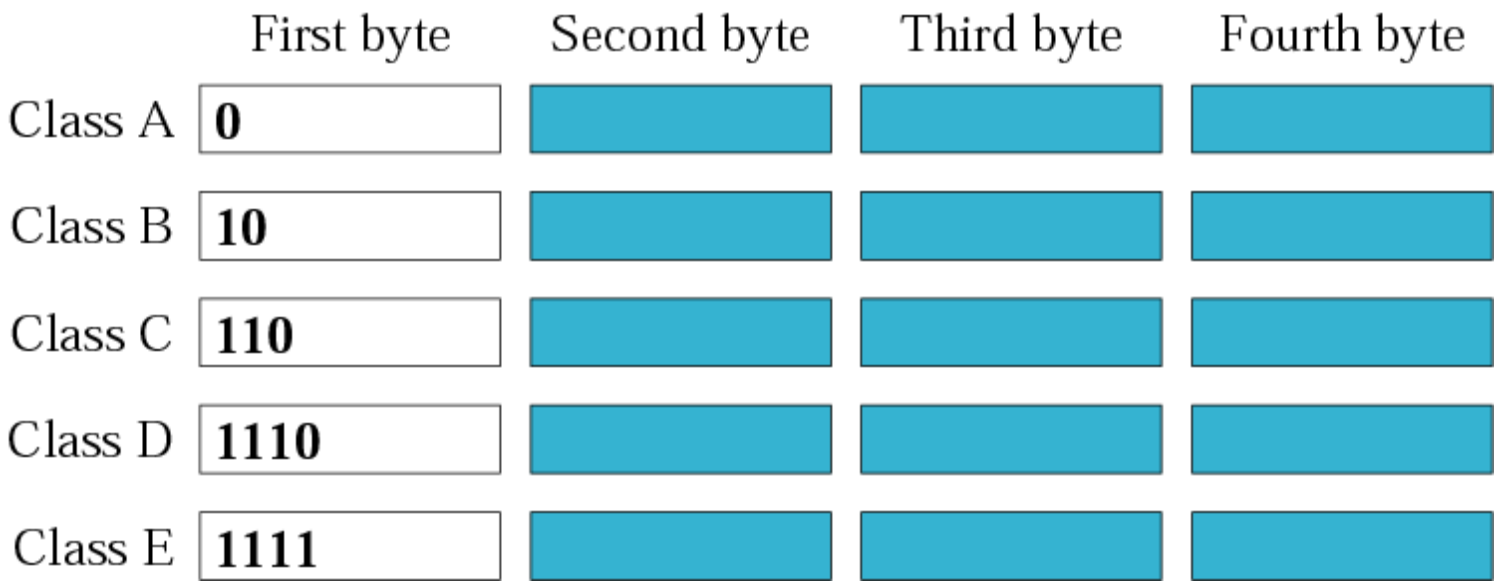
Occupation of the address space



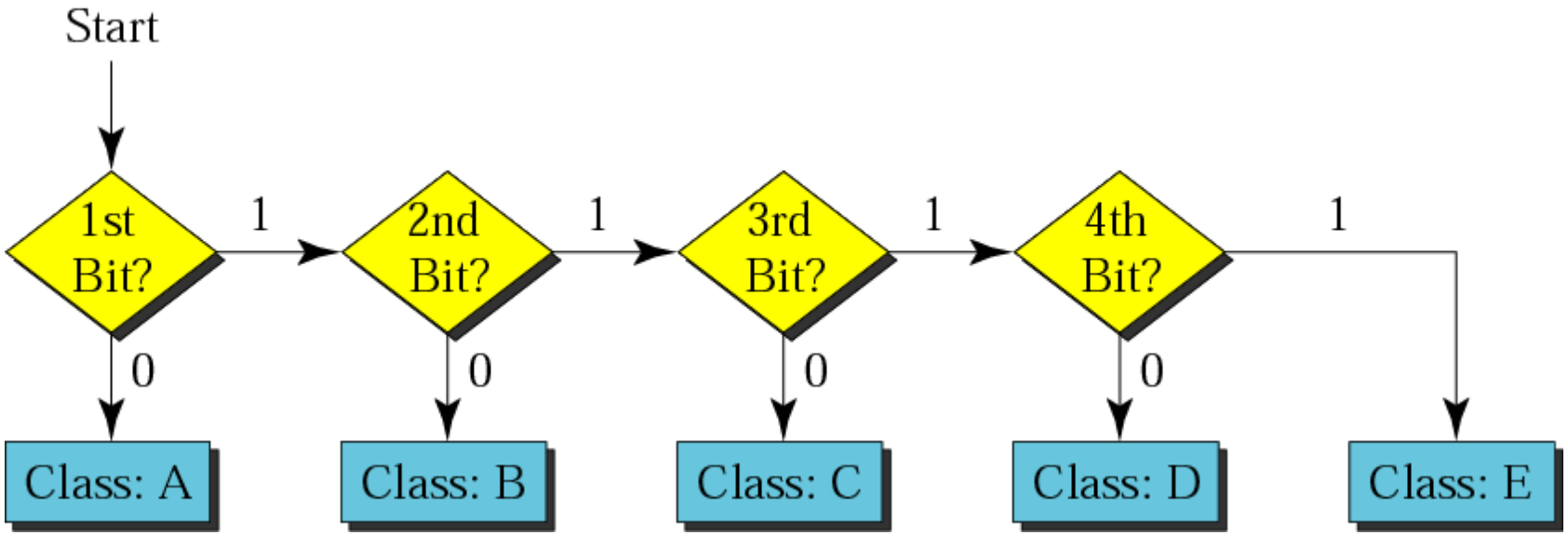
In classful addressing the address space is divided into 5 classes:

A, B, C, D, and E.

Finding the class in binary notation



Finding the address class



Example 5

Show that Class ***A*** *has*
2^{31} = 2,147,483,648 addresses

Example 6

Find the class of the following IP addresses

00000001 00001011 00001011 11101111

11000001 00001011 00001011 11101111

Solution

Example 6

Find the class of the following IP addresses

00000001 00001011 00001011 11101111

11000001 00001011 00001011 11101111

Solution

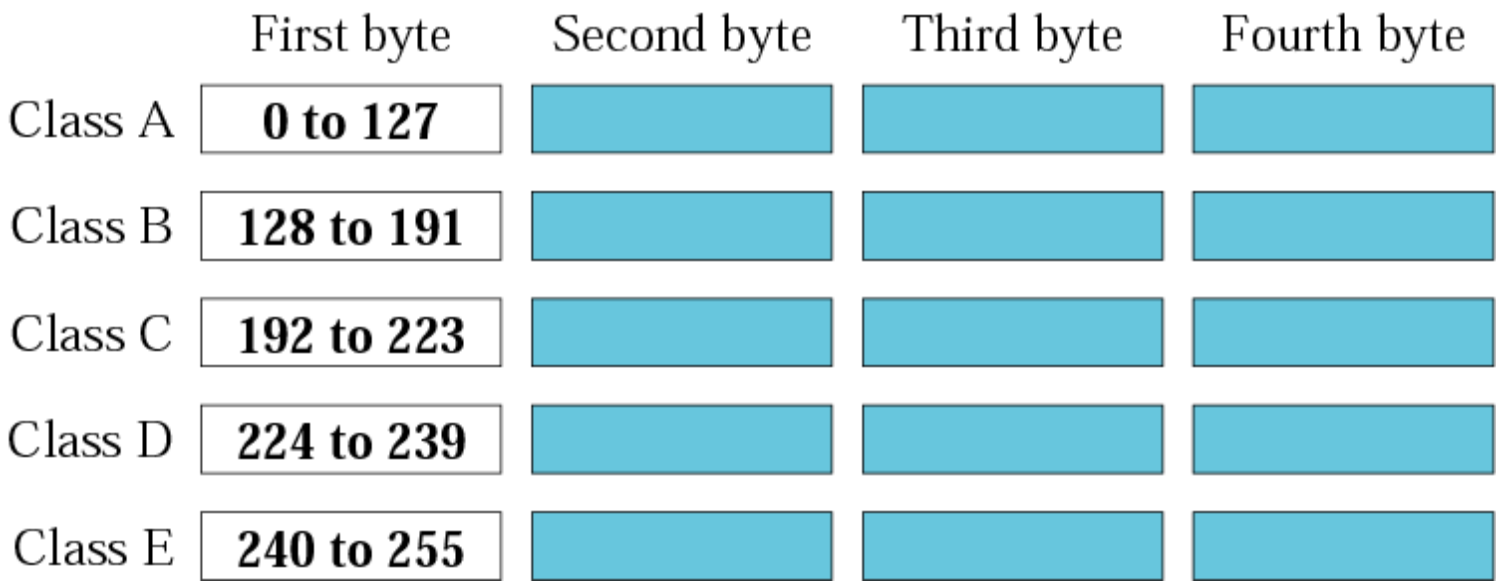
- **0**0000001 00001011 00001011 11101111

  1st is 0, hence it is Class A

- 11000001 00001011 00001011 11101111

  1st and 2nd bits are 1, and 3rd bit is 0 hence, Class C

Finding the class in decimal notation



Example 7

Find the class of the following addresses
158.223.1.108
227.13.14.88

Solution

Example 7

Find the class of the following addresses
158.223.1.108
227.13.14.88

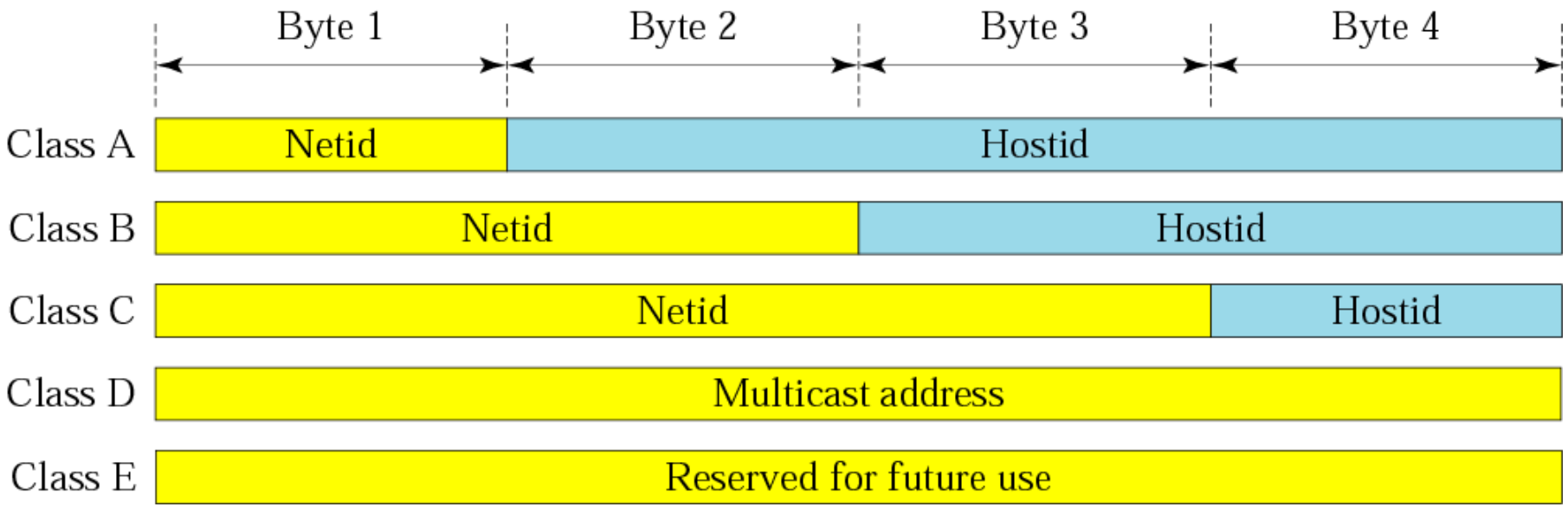
Solution

•158.223.1.108
1st byte = 158 (128<158<191) class B
•227.13.14.88
1st byte = 227 (224<227<239) class D

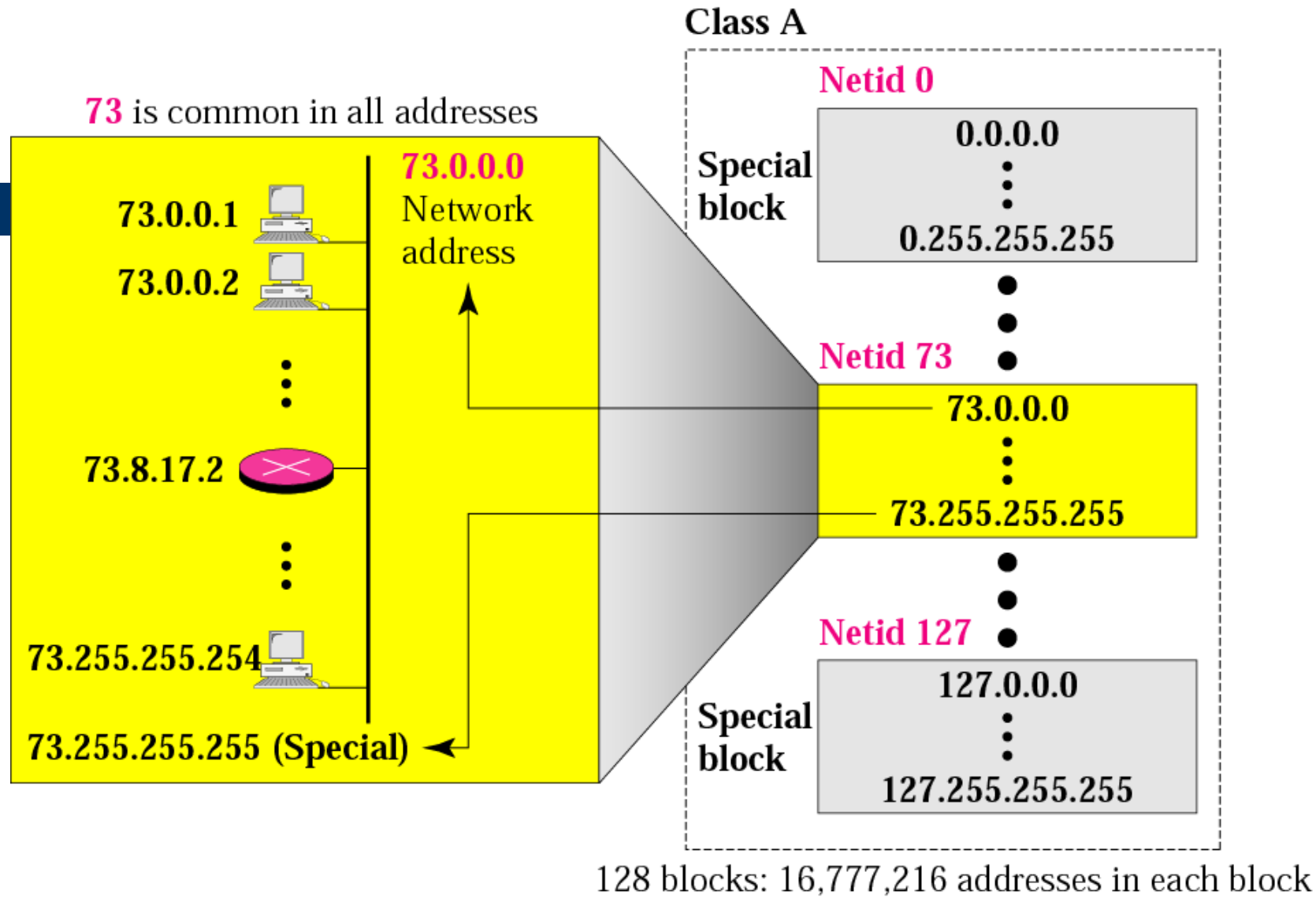
IP address with appending port number

- 158.128.1.108:25
- the for octet before colon is the IP address
- The number of colon (25) is the port number

Netid and hostid



Blocks in class A

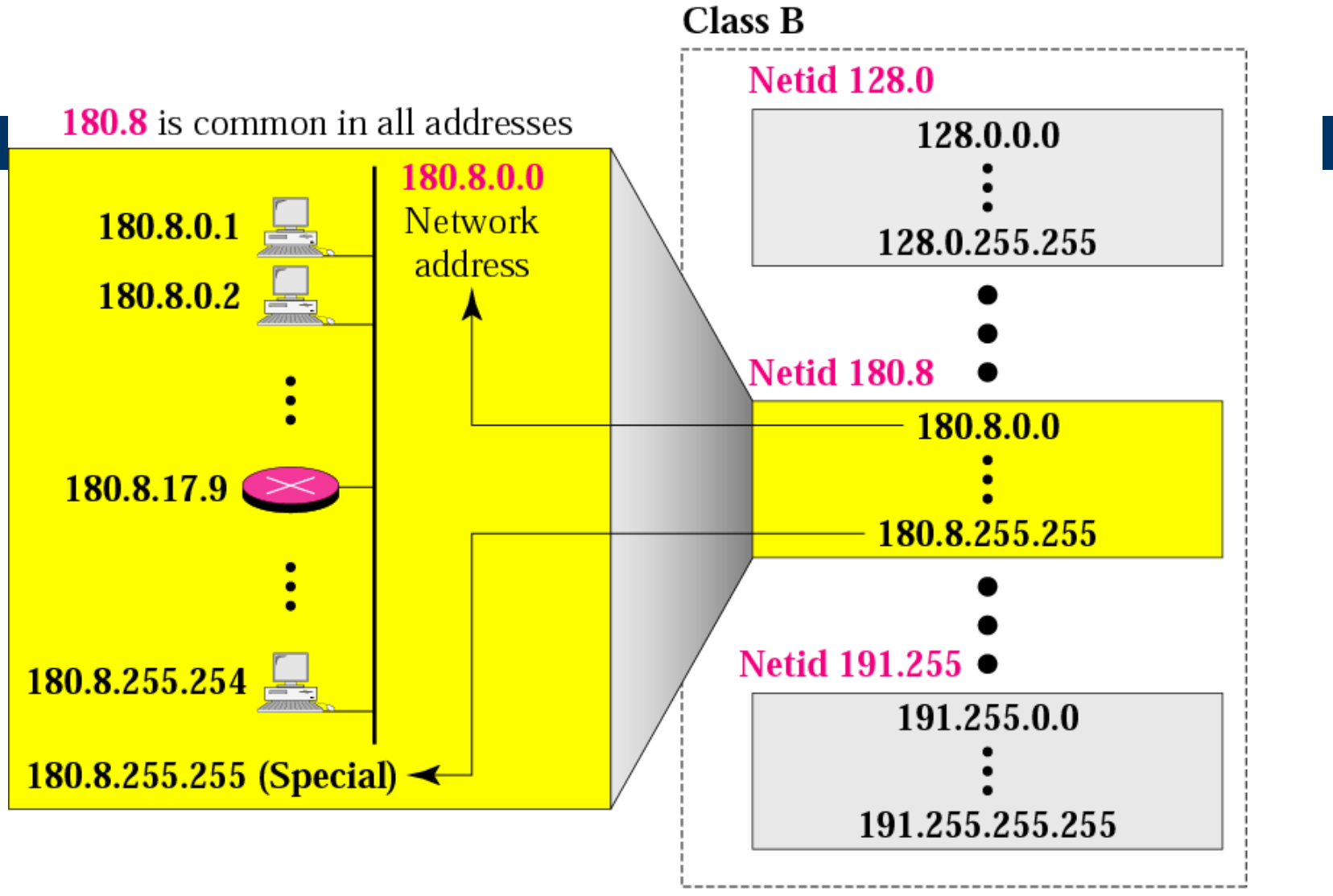


128 blocks: 16,777,216 addresses in each block

Note

Millions of class A addresses are wasted.

Blocks in class B

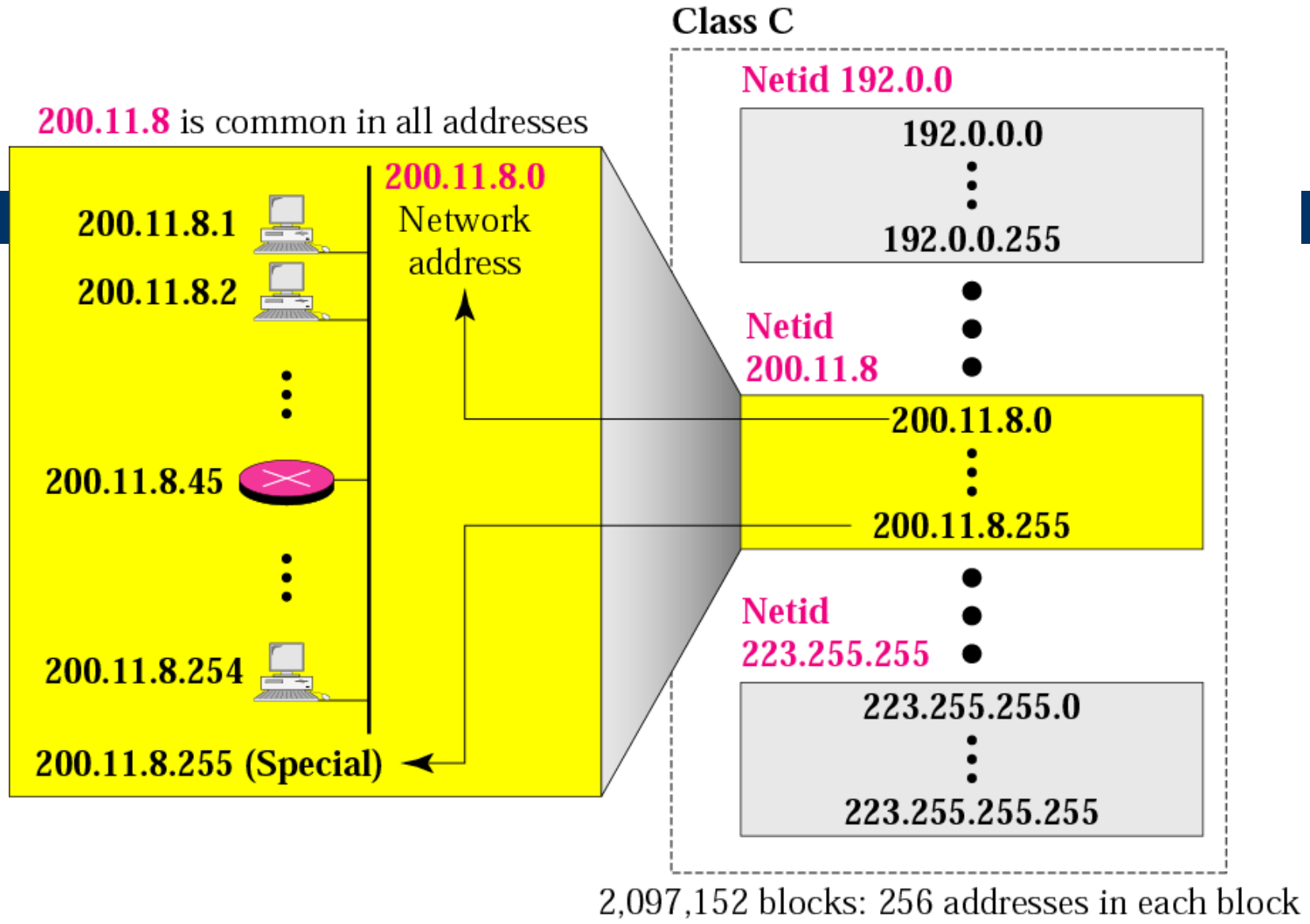


16,384 blocks: 65,536 addresses in each block

Note

Many class B addresses are wasted.

Blocks in class C



Note

The number of addresses in a class C block is smaller than the needs of most organizations.

Note

Class D addresses are used for multicasting; there is only one block in this class.

Note

Class E addresses are reserved for special purposes; most of the block is wasted.

Network Addresses

The network address is the first address.

The network address defines the network to the rest of the Internet.

Given the network address, we can find the class of the address, the block, and the range of the addresses in the block

Note

In classful addressing, the network address (the first address in the block) is the one that is assigned to the organization.

Example 8

Given the network address 132.21.0.0, find the class, the block, and the range of the addresses

Solution

Example 8

Given the network address 132.21.0.0, find the class, the block, and the range of the addresses

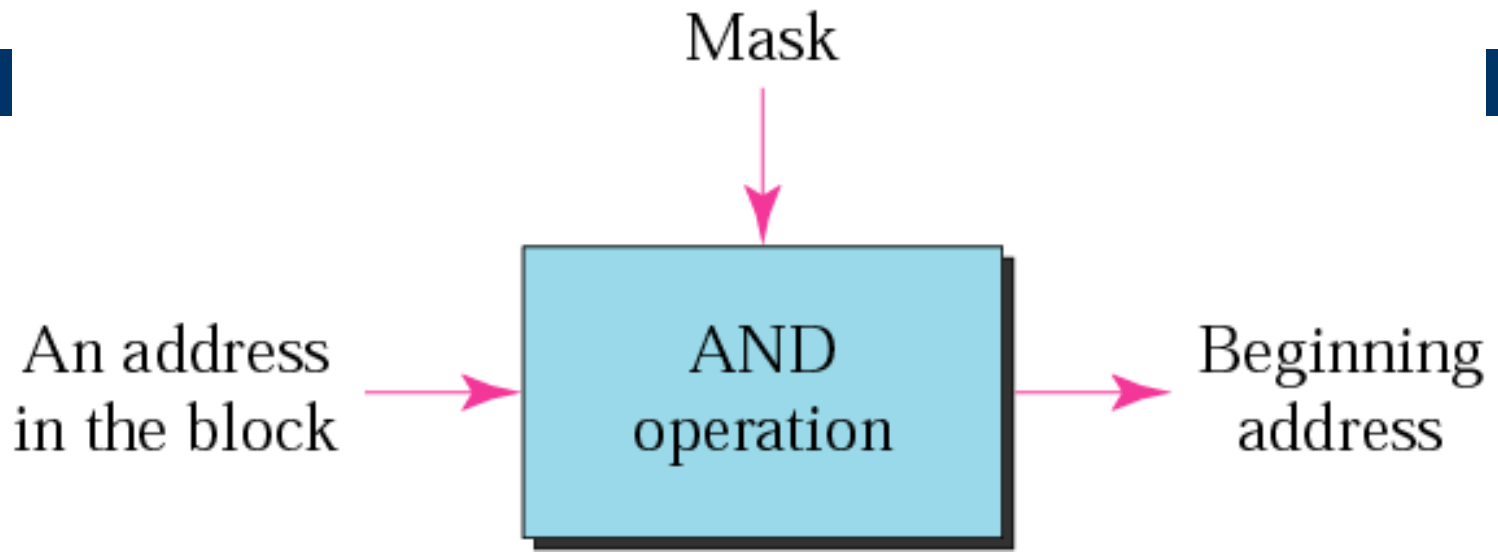
Solution

The 1st byte is between 128 and 191.
Hence, Class B
The block has a netid of 132.21.
The addresses range from
132.21.0.0 to 132.21.255.255.

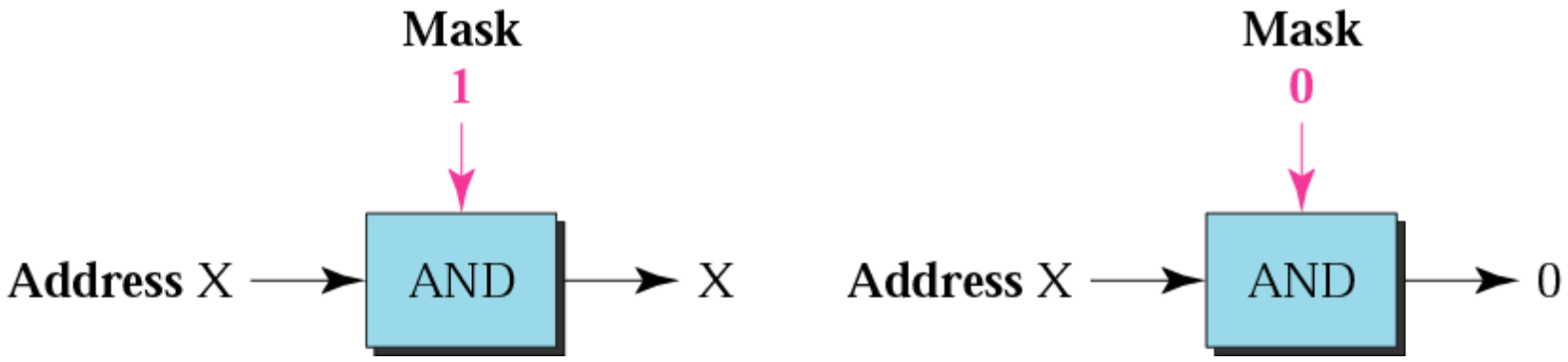
Mask

- A mask is a 32-bit binary number.
- The mask is ANDeD with IP address to get
  - The bloc address (Network address)
  - Mask And IP address = Block Address

Masking concept



AND operation



Note

The network address is the beginning address of each block. It can be found by applying the default mask to any of the addresses in the block (including itself). It retains the netid of the block and sets the hostid to zero.

Default Mak

- Class A default mask is 255.0.0.0
- Class B default mask is 255.255.0.0
- Class C Default mask 255.255.255.0

Chapter 5

Subnetting/Supernetting and Classless Addressing

CONTENTS

- **SUBNETTING**
- **SUPERNETTING**
- **CLASSLESS ADDRSSING**

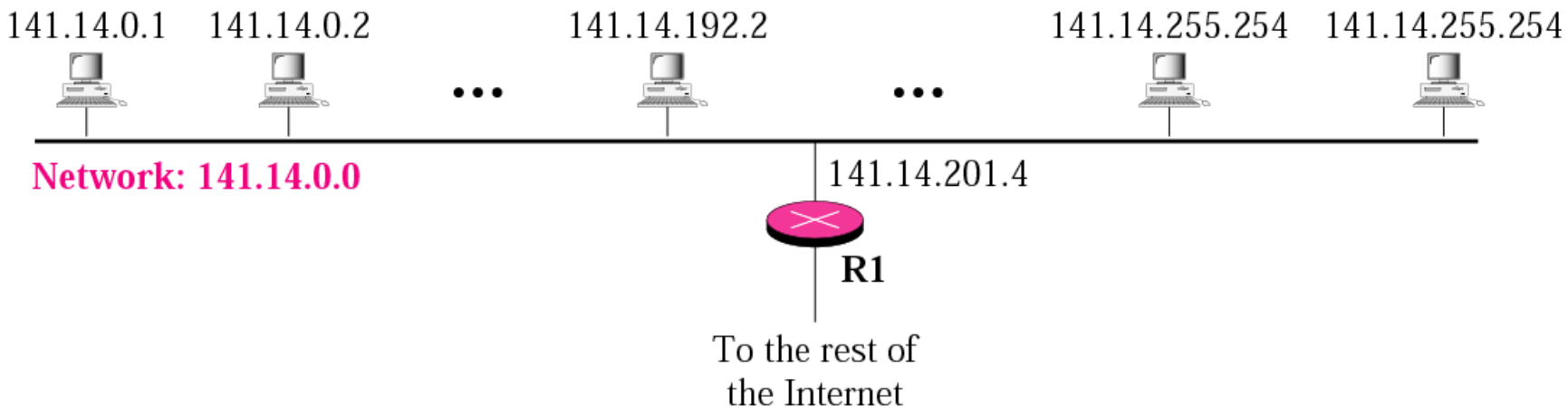
5.1

SUBNETTING

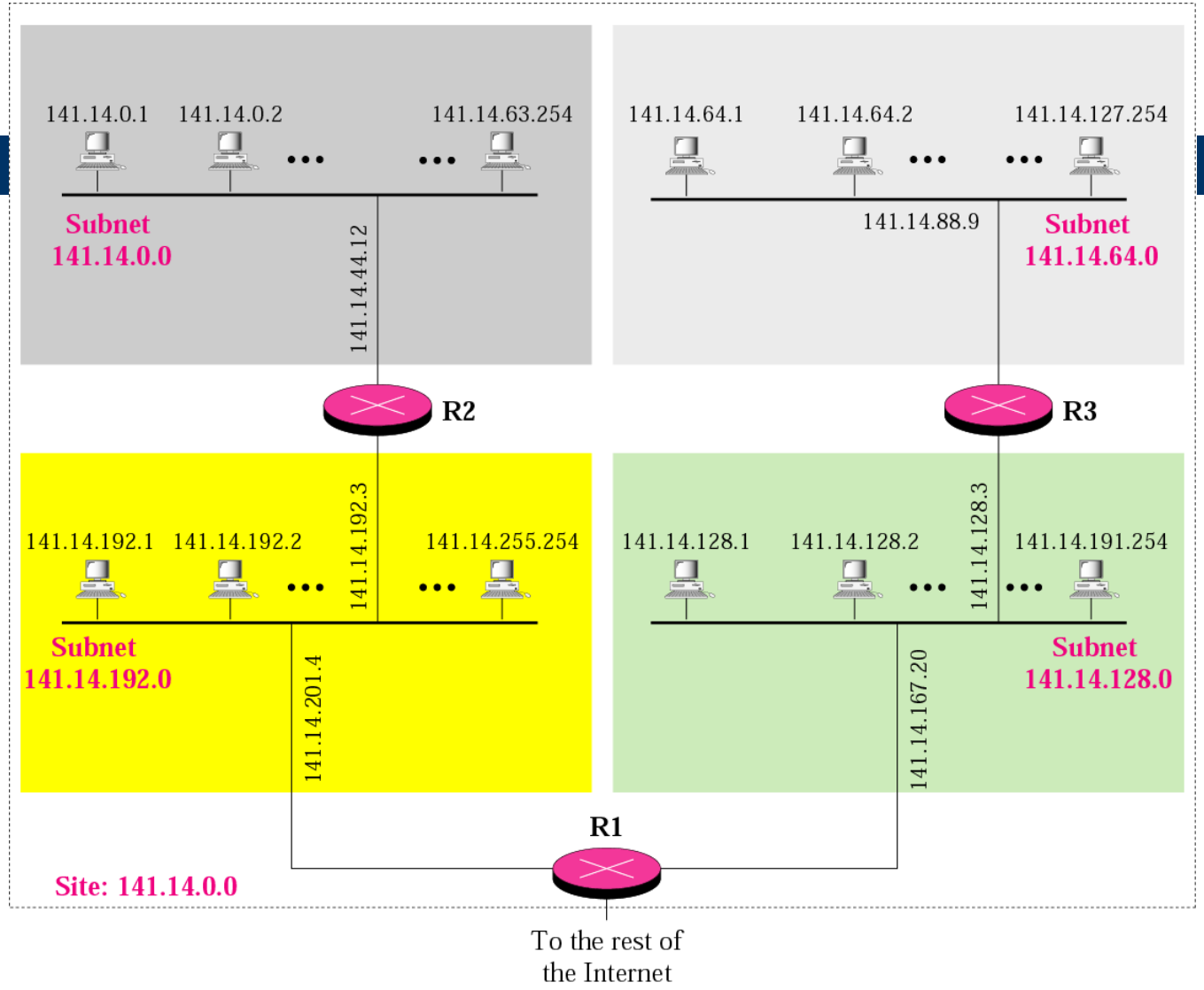
Note

IP addresses are designed with two levels of hierarchy.

A network with two levels of hierarchy (not subnetted)



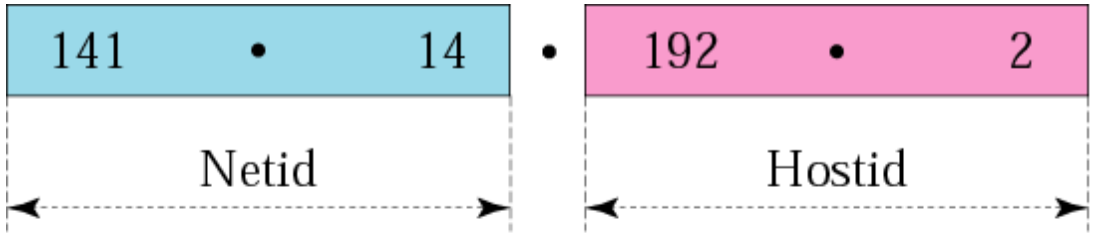
A network with three levels of hierarchy (subnetted)



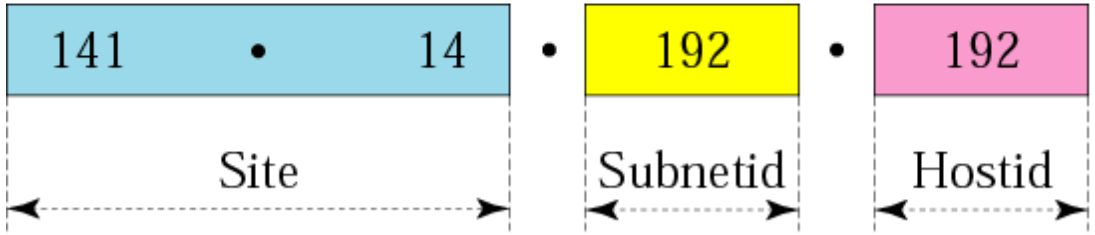
Note

- Subnetting is done by borrowing bits from the host part and add them the network part

Addresses in a network with and without subnetting

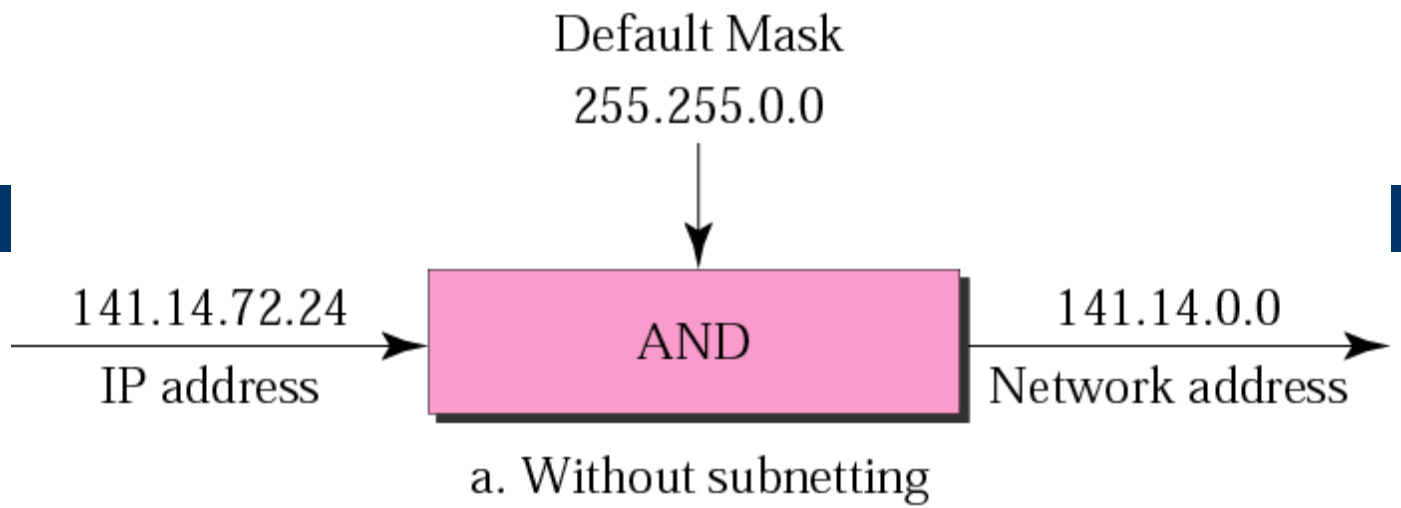


a. Without subnetting

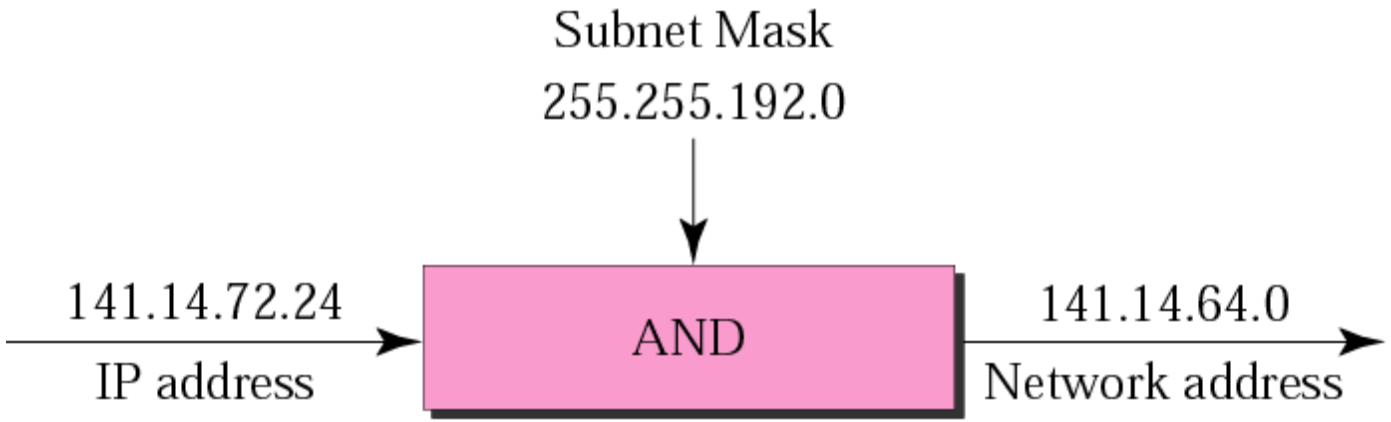


b. With subnetting

lt mask and subnet mask



a. Without subnetting



b. With subnetting

Finding the Subnet Address

Given an IP address, we can find the subnet address the same way we found the network address. We apply the mask to the address. We can do this in two ways: straight or short-cut.

Straight Method

In the straight method, we use binary notation for both the address and the mask and then apply the AND operation to find the subnet address.

Example 9

What is the subnetwork address if the destination address is 200.45.34.56 and the subnet mask is 255.255.240.0?

Solution

11001000 00101101 00100010 00111000

11111111 11111111 1111**0000** **00000000**

11001000 00101101 0010**0000** **00000000**

The subnetwork address is **200.45.32.0**.

Short-Cut Method

** If the byte in the mask is 255, copy the byte in the address.

** If the byte in the mask is 0, replace the byte in the address with 0.

** If the byte in the mask is neither 255 nor 0, we write the mask and the address in binary and apply the AND operation.

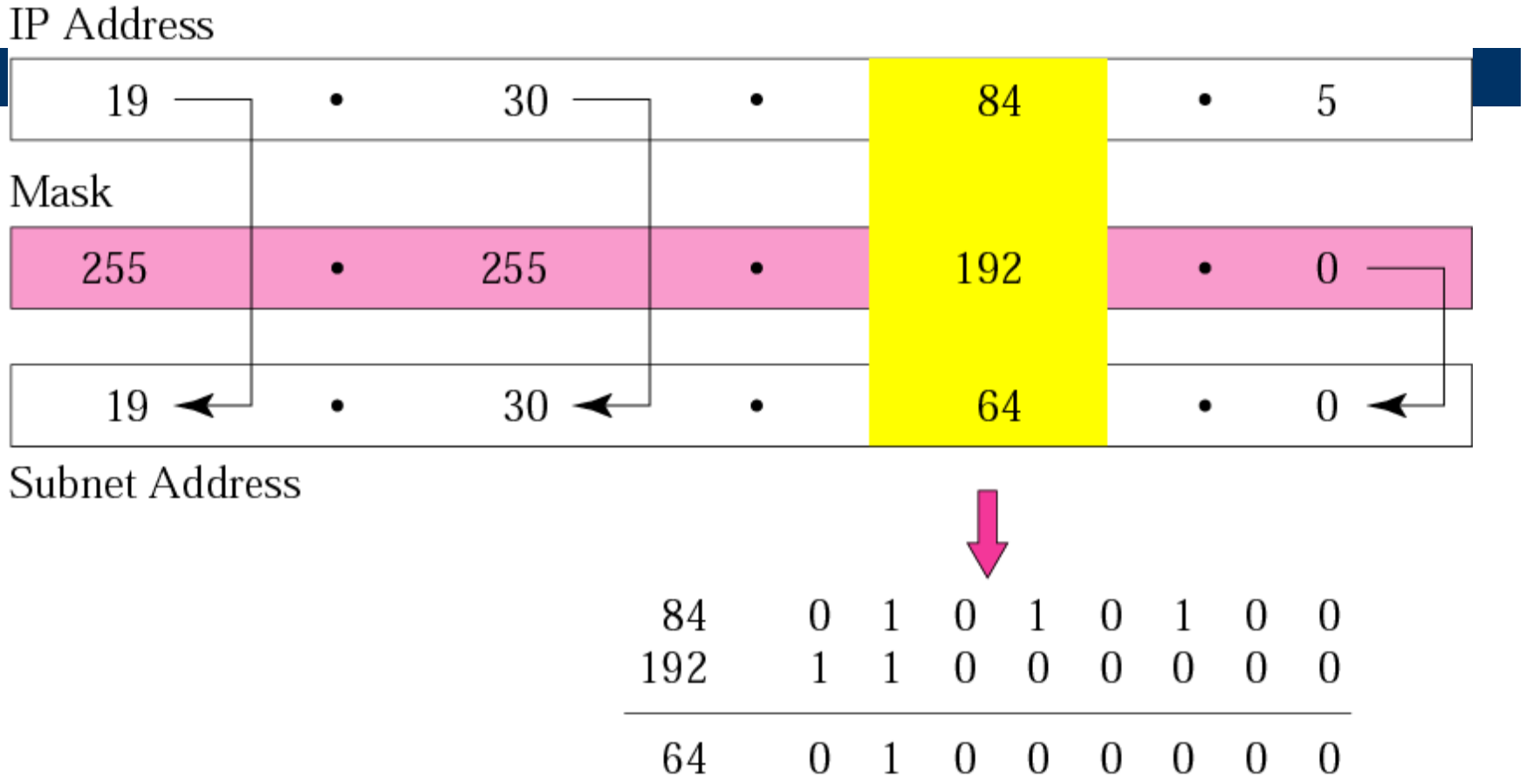
Example 10

What is the subnetwork address if the destination address is 19.30.80.5 and the mask is 255.255.192.0?

Solution

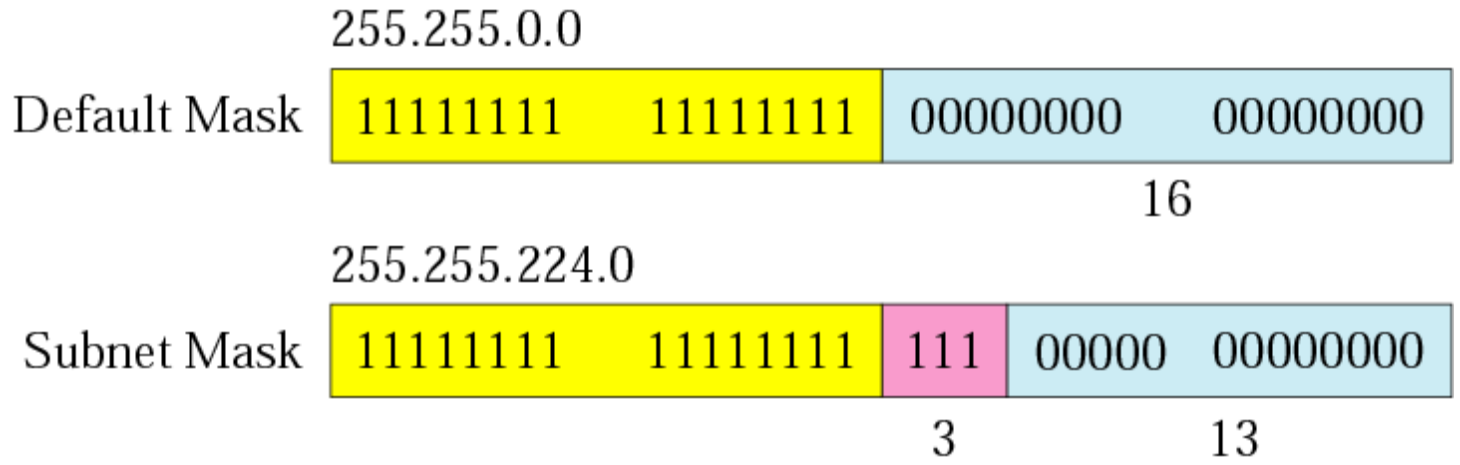
See next slide

Solution



84	0	1	0	1	0	1	0	0
192	1	1	0	0	0	0	0	0
64	0	1	0	0	0	0	0	0

Comparison of a default mask and a subnet mask



Note

The number of subnets must be a power of 2.