Data Communications and Networking seek likeling

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Chapter 19

Network Layer: Logical Addressing

19-1 IPv4 ADDRESSES

An IPv4 address is a 32-bit address that uniquely and universally defines the connection of a device (for example, a computer or a router) to the Internet.

Topics discussed in this section:

Address Space

Notations

Classful Addressing

Classless Addressing

Network Address Translation (NAT)



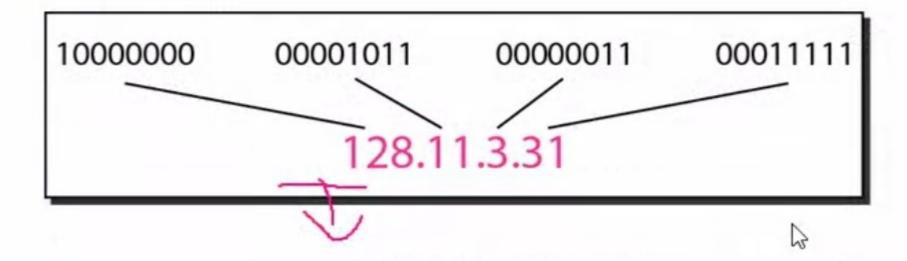
Address Space

Address Space

A protocol such as IPv4 that defines addresses has an address space. An address space is the total number of addresses used by the protocol. If a protocol uses N bits to define an address, the address space is 2^N because each bit can have two different values (0 or 1) and N bits can have 2^N values.

IPv4 uses 32-bit addresses, which means that the address space is 2³² or 4,294,967,296 (more than 4 billion). This means that, theoretically, if there were no restrictions, more than 4 billion devices could be connected to the Internet. We will see shortly that the actual number is much less because of the restrictions imposed on the addresses.

Figure 19.1 Dotted-decimal notation and binary notation for an IPv4 address



Example 19.1

Change the following IPv4 addresses from binary notation to dotted-decimal notation.

- a. 10000001 00001011 00001011 11101111
- b. 11000001 10000011 00011011 11111111

Solution

We replace each group of 8 bits with its equivalent decimal number and add dots for separation.

- a. 129.11.11.239
- b. 193.131.27.255

Example 19.3

Find the error, if any, in the following IPv4 addresses.

- a. 111.56.045.78
- b. 221.34.7.8.20
- c. 75.45.301.14
- d. 11100010.23.14.67

Solution

- a. There must be no leading zero (045).
- b. There can be no more than four numbers.
- c. Each number needs to be less than or equal to 255.
- d. A mixture of binary notation and dotted-decimal notation is not allowed.



The address space of IPv4 is 2³² or 4,294,967,296.



Notations

There are two prevalent notations to show an IPv4 address: binary notation and dotteddecimal notation.

Binary Notation

In binary notation, the IPv4 address is displayed as 32 bits. Each octet is often referred to as a byte. So it is common to hear an IPv4 address referred to as a 32-bit address or a 4-byte address. The following is an example of an IPv4 address in binary notation:

01110101 10010101 00011101 00000010



Dotted-Decimal Notation

To make the IPv4 address more compact and easier to read, Internet addresses are usually written in decimal form with a decimal point (dot) separating the bytes. The following is the dotted-decimal notation of the above address: