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)



An IPv4 address is 32 bits long.

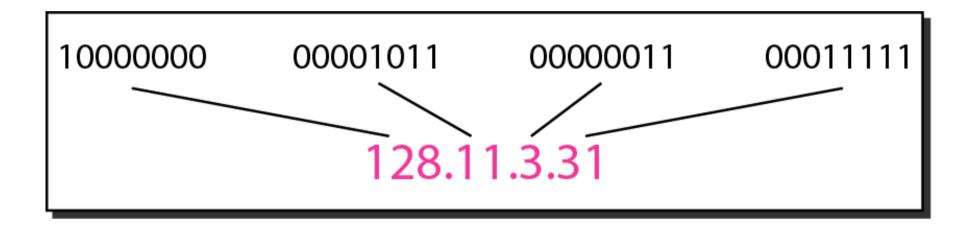


The IPv4 addresses are unique and universal.



The address space of IPv4 is 2^{32} or 4,294,967,296.

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

Solution

We replace each group of 8 bits with its equivalent decimal number (see Appendix B) and add dots for separation.

- a. 129.11.11.239
- b. 193.131.27.255

Example 19.2

Change the following IPv4 addresses from dotteddecimal notation to binary notation.

- a. 111.56.45.78
- **b.** 221.34.7.82

Solution

We replace each decimal number with its binary equivalent (see Appendix B).

- a. 01101111 00111000 00101101 01001110
- b. 11011101 00100010 00000111 01010010

Note

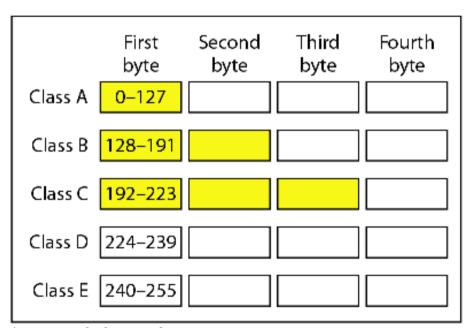
In classful addressing, the address space is divided into five classes:

A, B, C, D, and E.

Figure 19.2 Finding the classes in binary and dotted-decimal notation

	First byte	Second byte	Third byte	Fourth byte
Class A	0			
Class B	10			
Class C	110			
Class D	1110			
Class E	1111			

a. Binary notation



b. Dotted-decimal notation

Example 19.4

Find the class of each address.

- a. 00000001 00001011 00001011 11101111
- *b*. <u>110</u>00001 10000011 00011011 11111111
- *c.* **14**.23.120.8
- *d.* 252.5.15.111

Solution

- a. The first bit is 0. This is a class A address.
- b. The first 2 bits are 1; the third bit is 0. This is a class C
 - address.
 - c. The first byte is 14; the class is A.
- 1 The first byte is 252; the class is E.

Table 19.1 Number of blocks and block size in classful IPv4 addressing

Class	Number of Blocks	Block Size	Application
A	128	16,777,216	Unicast
В	16,384	65,536	Unicast
С	2,097,152	256	Unicast
D	1	268,435,456	Multicast
Е	1	268,435,456	Reserved

Note

In classful addressing, a large part of the available addresses were wasted.

Table 19.2 Default masks for classful addressing

Class	Binary	Dotted-Decimal	CIDR
A	1111111 00000000 00000000 00000000	255 .0.0.0	/8
В	11111111 11111111 00000000 00000000	255.255. 0.0	/16
С	11111111 11111111 11111111 00000000	255.255.255.0	/24

Note

Classful addressing, which is almost obsolete, is replaced with classless addressing.

19-2 IPv6 ADDRESSES

Despite all short-term solutions, address depletion is still a long-term problem for the Internet. This and other problems in the IP protocol itself have been the motivation for IPv6.

Topics discussed in this section:

Structure Address Space



An IPv6 address is 128 bits long.

Figure 19.14 IPv6 address in binary and hexadecimal colon notation

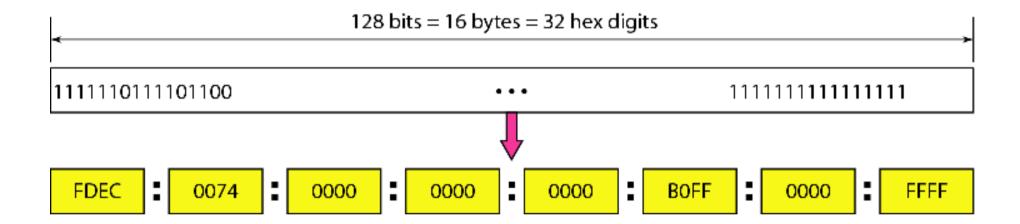


Figure 19.15 Abbreviated IPv6 addresses

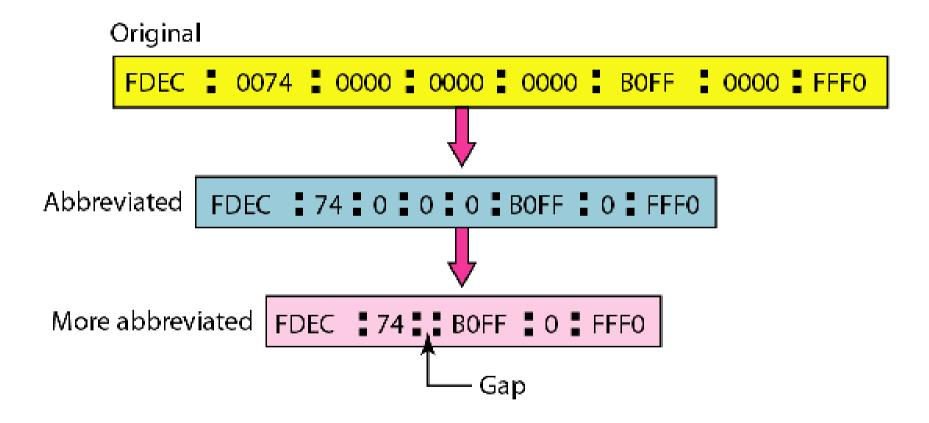


Figure 19.18 Reserved addresses in IPv6

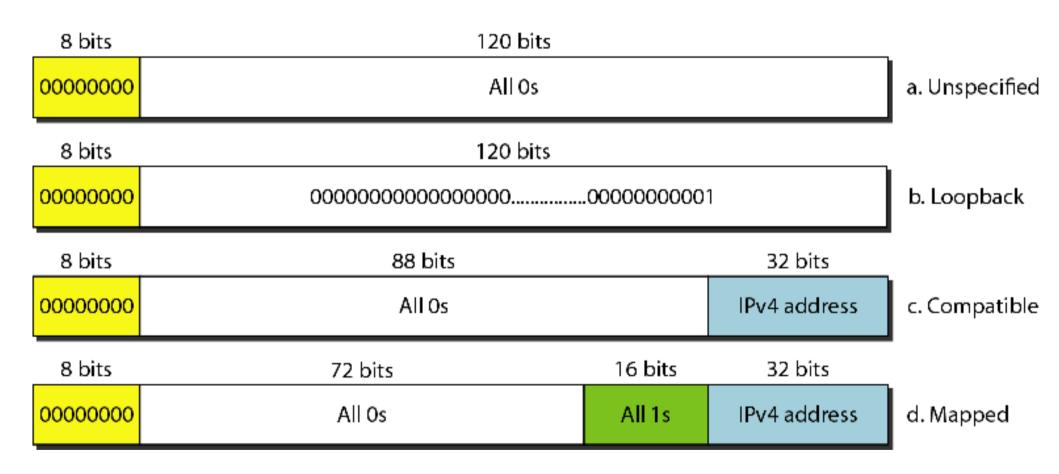


Figure 19.19 Local addresses in IPv6

