Network Layer: Logical Addressing

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.

Note

An IPv4 address is 32 bits long.

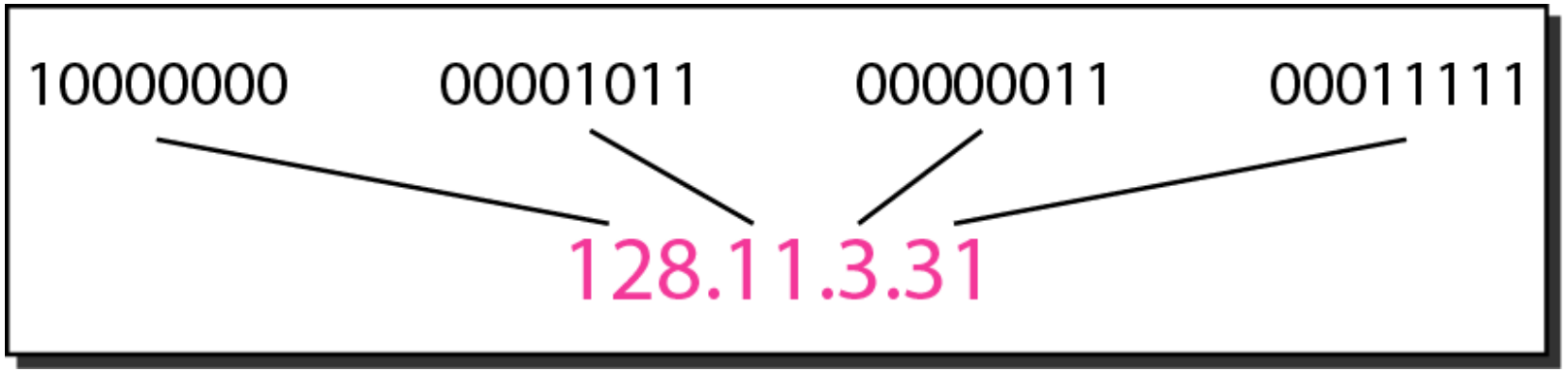
Note

The IPv4 addresses are unique and universal.

Note

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

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



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.

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a. 129.11.11.239

b. 193.131.27.255

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

a. 111.56.45.78

b. 221.34.7.82

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We replace each decimal number with its binary equivalent

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a. 01101111 00111000 00101101 01001110

b. 11011101 00100010 00000111 01010010

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

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

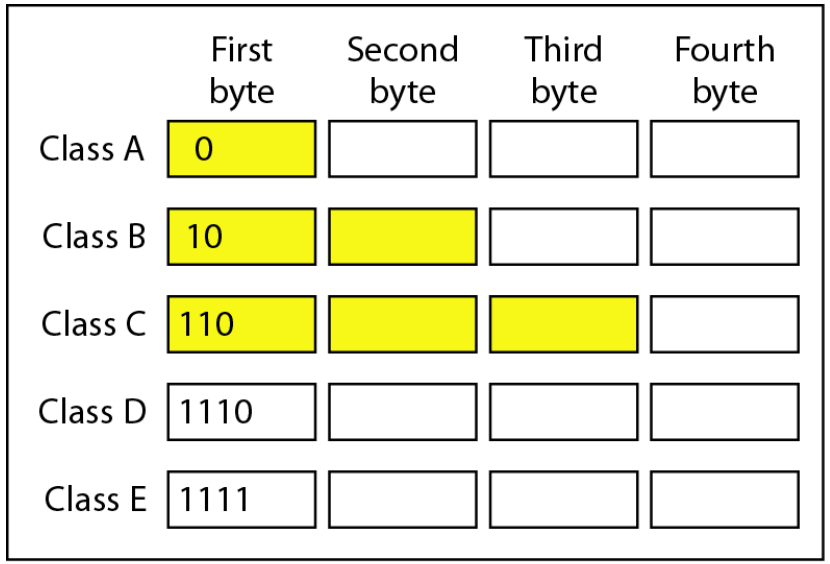
Solution

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.

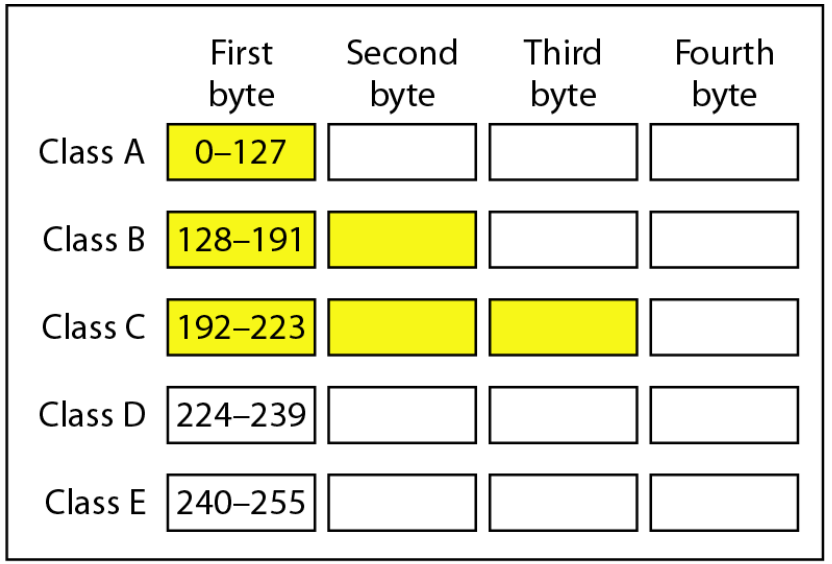
Note

In classful addressing, the address space is divided into five classes: A, B, C, D, and E.

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



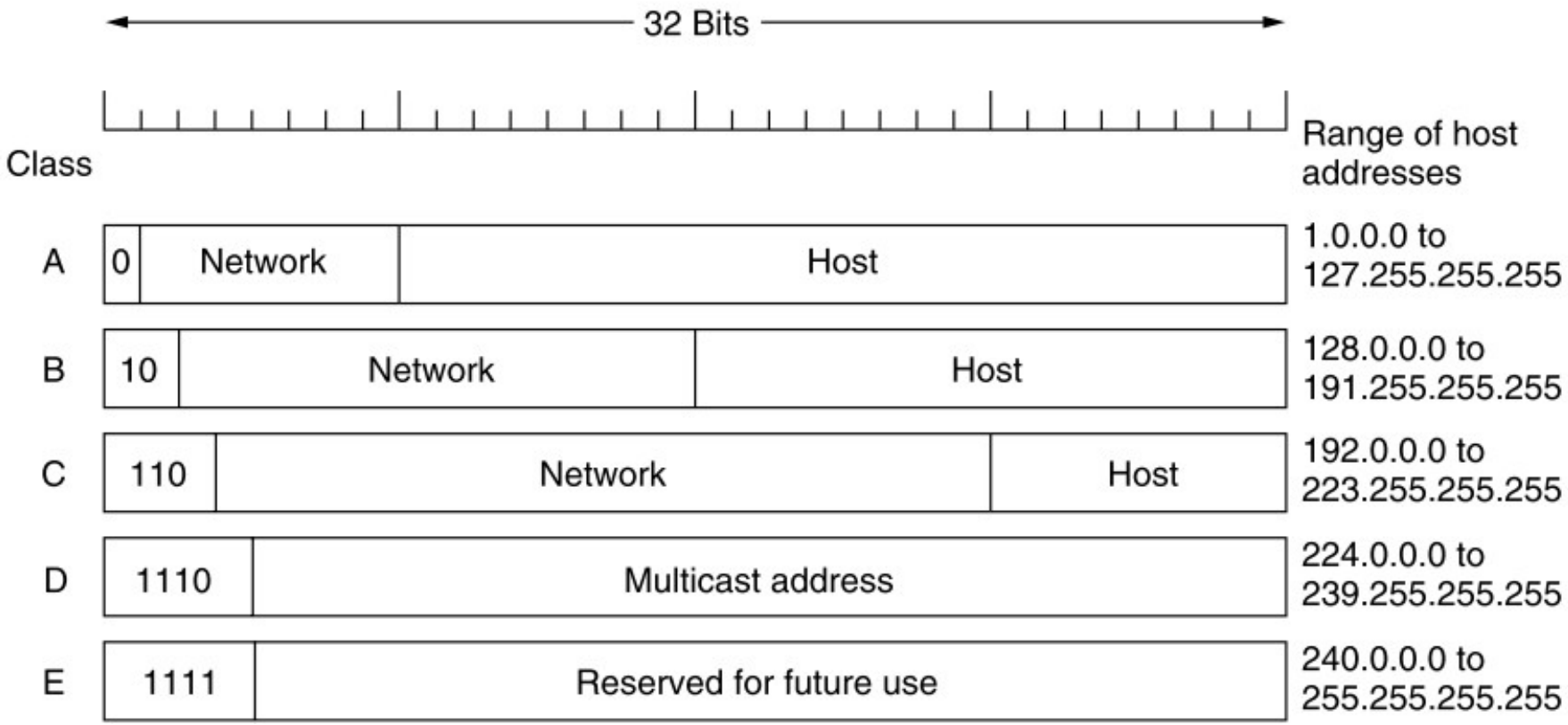
a. Binary notation



b. Dotted-decimal notation

1. **Network ID** represents the IP Address of the network and is used to identify the network.
2. **Host ID** represents the IP Address of the host and is used to identify the host within the network.

Format of an IP Address


32 Bits
Class
Range of host addresses
A
0
Network
Host
1.0.0.0 to 127.255.255.255
B
10
Network
Host
128.0.0.0 to 191.255.255.255
C
110
Network
Host
192.0.0.0 to 223.255.255.255
D
1110
Multicast address
224.0.0.0 to 239.255.255.255
E
1111
Reserved for future use
240.0.0.0 to 255.255.255.255

Find the class of each address.

a. 00000001 00001011 00001011 11101111

b. 11000001 10000011 00011011 11111111

c. 14.23.120.8

d. 252.5.15.111

Find the class of each address.

a. 00000001 00001011 00001011 11101111
b. 11000001 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.*
d. *The first byte is 252; the class is E.*

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

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

Class of IP Address	Total Number of IP Addresses	1st Octet Decimal Range	Number of Networks available	Hosts per network	Default Subnet Mask
Class A	2^{31}	1 – 126	$2^{7} - 2$	$2^{24} - 2$	255.0.0.0
Class B	2^{30}	128 – 191	2^{14}	$2^{16} - 2$	255.255.0.0
Class C	2^{29}	192 – 223	2^{21}	$2^{8} - 2$	255.255.255.0
Class D	2^{28}	224 – 239	Not defined	Not defined	Not defined
Class E	2^{28}	240 – 254	Not defined	Not defined	Not defined

In class A, total number of IP Addresses available for networks are 2 less.

- This is to account for the two reserved network IP Addresses 0.xxx.xxx.xxx and 127.xxx.xxx.xxx.
- IP Address 0.0.0.0 is reserved for broadcasting requirements.
- IP Address 127.0.0.1 is reserved for loopback address used for software testing.

In all the classes, total number of hosts that can be configured are 2 less.

- This is to account for the two reserved IP addresses in which all the bits for host ID are either zero or one.
- When all Host ID bits are 0, it represents the Network ID for the network(NID).
- When all Host ID bits are 1, it represents the Broadcast Address(DBA).

Note

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

IPv6 - Address

IPv6 Address format, we shall look into Hexadecimal Number System. Hexadecimal is a positional number system that uses radix (base) of 16. To represent the values in readable format, this system uses 0-9 symbols to represent values from zero to nine and A-F to represent values from ten to fifteen. Every digit in Hexadecimal can represent values from 0 to 15.

Address Structure

An IPv6 address is made of 128 bits divided into eight 16-bits blocks. Each block is then converted into 4-digit Hexadecimal numbers separated by colon symbols.

For example, given below is a 128 bit IPv6 address represented in binary format and

```
0010000000000001 0000000000000000 0011001000111000 1101111111100001
0000000001100011 0000000000000000 0000000000000000 1111111011111011
```

Each block is then co

```
2001:0000:3238:DFE1:0063:0000:0000:FEFB
```

y ‘:’ symbol:

IPv6 looks different than IPv4 but there are some similarities. For example we have unicast addresses and we still have a “public” and “private” range. We use different names for these but the idea is the same.