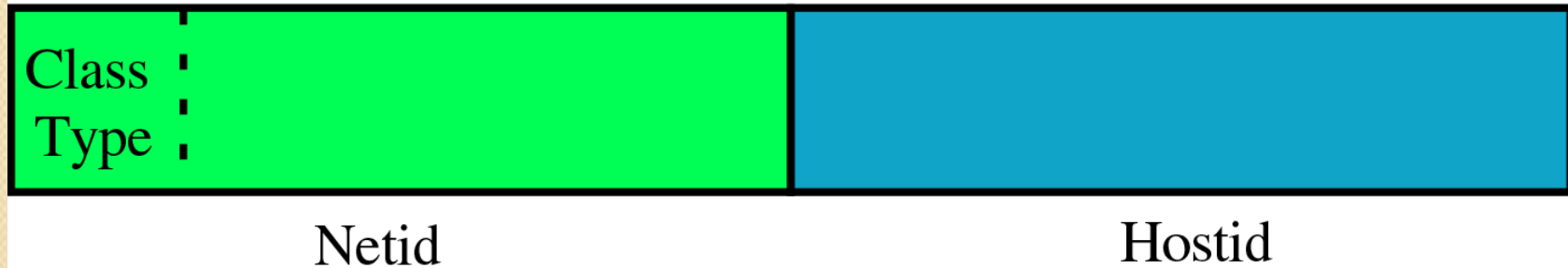# IP v4 Addressing

Introduction

An Internet address is made of four bytes (32 bits) that define a host's connection to a network.

Class Type	Netid	Hostid

Note

*An IP address is a
32-bit
address.*

Note

The IP addresses
are
unique.

RULE:

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 and 1) and *N* bits can have 2^N values.

Note

The address space of IPv4 is

$$2^{32}$$

or

4,294,967,296.

An address space is the total number of addresses used by the protocol.

Binary Notation

01110101 10010101 00011101 11101010

Dotted-decimal notation

10000000　　　00001011　　　00000011　　　00011111

128.11.3.31

Example 1

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

10000001 00001011   00001011

11

129.11.11.239

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, if any, in the following IP address:

111.56.045.78

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

Example 3 (continued)

Find the error, if any, in the following IP address:

75.45.301.14

Solution

In dotted-decimal notation, each number is less than or equal to 255; 301 is outside this range.
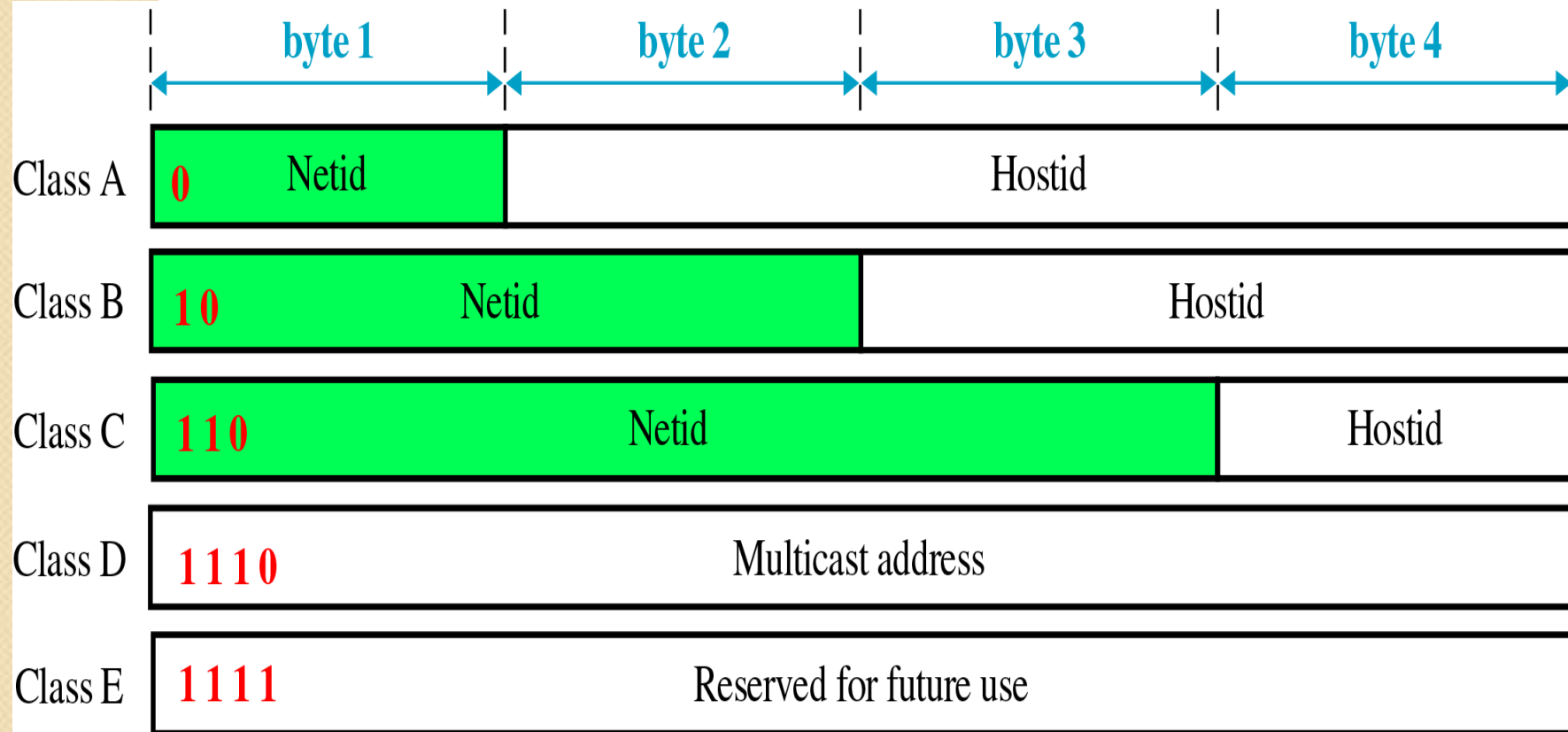
Unicast, Multicast, and Reserved Addresses

Addresses in classes A, B, and C are for unicast communication, from one source to one destination. A host needs to have at least one **unicast address** to be able to send or receive packets.

Addresses in class D are for multicast communication, from one source to a group of destinations. If a host belongs to a group or groups, it may have one or more multicast addresses. A **multicast address** can be used only as a destination address, but never as a source address.
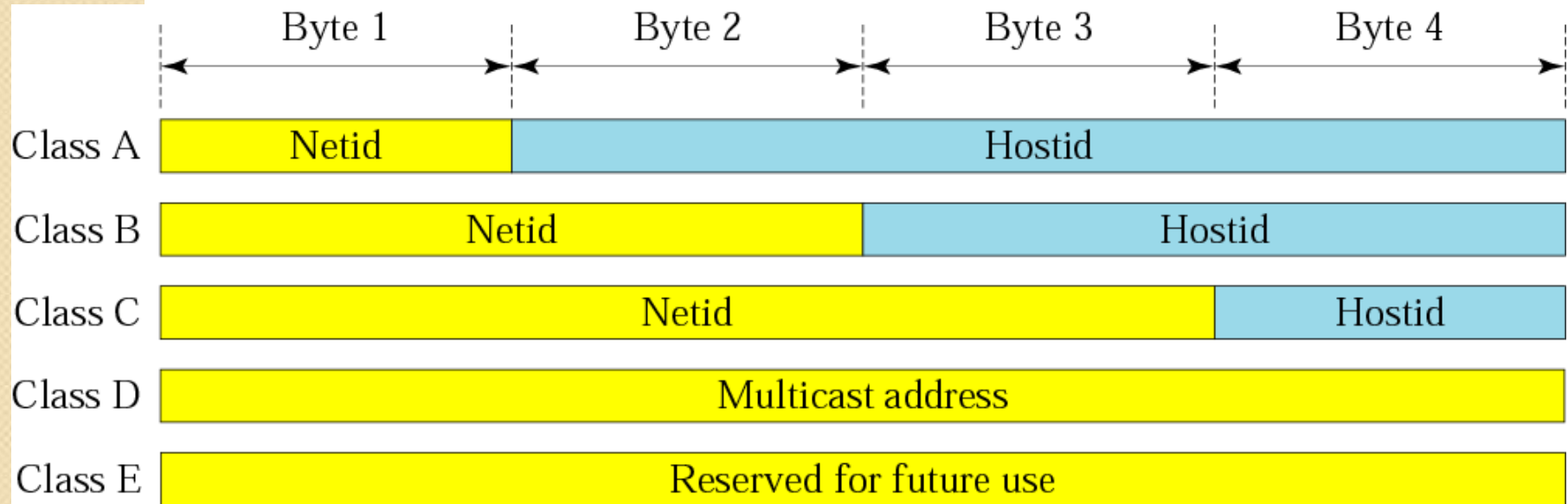
Addresses in class E are reserved. The original idea was to use them for special purposes. They have been used only in a few cases.

Every router and host on internet has a unique IP address .all IP address are of 32 bit and they use source and destination field of the IP header. The first part of address is called network ID which identify the network on the internet and second called the host ID used to identify the individual host on that network.

Classes of IP address :-

	byte 1		byte 2	byte 3		byte 4
Class A	0 Netid		Hostid			
Class B	1 0 Netid			Hostid		
Class C	1 1 0 Netid				Hostid	
Class D	1110 Multicast address					
Class E	1111 Reserved for future use					

Netid and hostid

	Byte 1	Byte 2	Byte 3	Byte 4

Class A — Netid | Hostid

Class B — Netid | Hostid

Class C — Netid | Hostid

Class D — Multicast address

Class E — Reserved for future use
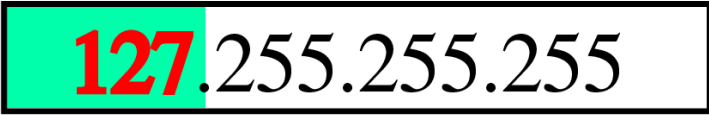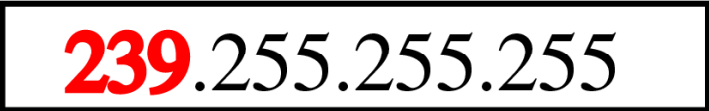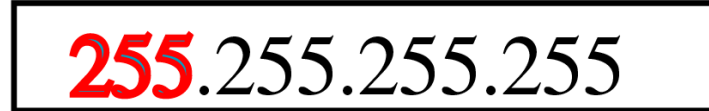
Note

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

Class Ranges of Internet Addresses

From

To

Class A

0.0.0.0
Netid — Hostid

127.255.255.255
Netid — Hostid

Class B

128.0.0.0
Netid — Hostid

191.255.255.255
Netid — Hostid

Class C

192.0.0.0
Netid — Hostid

223.255.255.255
Netid — Hostid

Class D

224.0.0.0
Group address

239.255.255.255
Group address

Class E

240.0.0.0
Undefined

255.255.255.255
Undefined

Class A address

32 bit

0	7 bit / network ID	24 bit host ID

The n/w field is of 7 bit and the host field is of 24 bits . One bit is used for the class type. So the n/w field can have numbers b/w 0 to 127. but the host number ranges from 0.0.0.0 to 127.255.255.255. hence in class A there can be 127 types of n/w's. bit 0 in fist field indicates that it is class A n/w address.

2^7 2^6 2^5 2^4 2^3 2^2 2^1 2^0

0 0 0 0 0 0 0 0 $\longrightarrow$ 0

0 0 0 0 0 0 0 1

.

0 1 1 1 1 1 1 1

10000000   0000 10 II   00000011   00011111

128.11.3.31

127
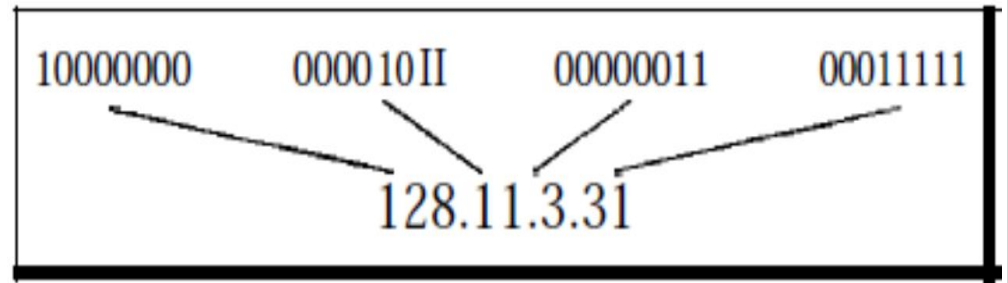
Same way total number of host will be ranges from 0. 0.0.0 to 127. 255.255.255

Class A address

32 bit

0	Network ID (7 bit)	Host ID (24 bit)

7 bit

24 bit

0	0 0 0 0 0 0	0 0 0 0 0 0 0	0 0 0 0 0 0 0	00000000

2^7 2^6 2^5 2^4 2^3 2^2 2^1 2^0 2^7 2^6 2^5 2^4 2^3 2^2 2^1 2^0 2^7 2^6 2^5 2^4 2^3 2^2 2^1 2^0

0	0 0 0 0 0 0	0 0 0 0 0 0 0 0	0 0 0 0 0 0 0	000000000

0

0

0

0

0.0.0.0

0	1 1 1 1 1 1	1 1 1 1 1 1 1 1	1 1 1 1 1 1 1	11111111

127

255

255

255

127.255.255.255

Blocks in class A

73 is common in all addresses

73.0.0.0 Network address

73.0.0.1
73.0.0.2

73.8.17.2

73.255.255.254
73.255.255.255 (Special)

Class A

Netid 0

Special block

0.0.0.0
•
•
•
0.255.255.255

Netid 73

73.0.0.0
•
•
•
73.255.255.255

Netid 127

Special block

127.0.0.0
•
•
•
127.255.255.255

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

Network Address in Class A

- Class A divided in to 128 blocks.
- We can assign class A addresses to 128 org.'s. each having 16,777,216 nodes .
- Each block have different netid. First block covers address from **0**.0.0.0 to **0**.255.255.255. here netid is 0.
- 2nd block covers from **1**.0.0.0 to **1**.255.255.255 with netid as **1.**
- Last block covers addresses from 127.0.0.0 to 127.255.255.255 with netid as 127.
- **The first address of each block is used as network address** which assigned to any organization and identify the organization to the rest of network.
- **A network address is an address that defines a network. It can not assigned to a host. A n/w address is netid+hostid .**

Note

Millions of class A addresses are wasted.

Class B address

32 bit

10	14 bit / network id	16 bit / host id

The first field defines the class type and second field defines the networks. And last field defines the hosts. The n/w field values lies b/w 128 to 191. The first block covers the address from 128.0.0.0 to 128.255.255.255 and last block covers from 191.0.0.0 to 191.255.255.255.
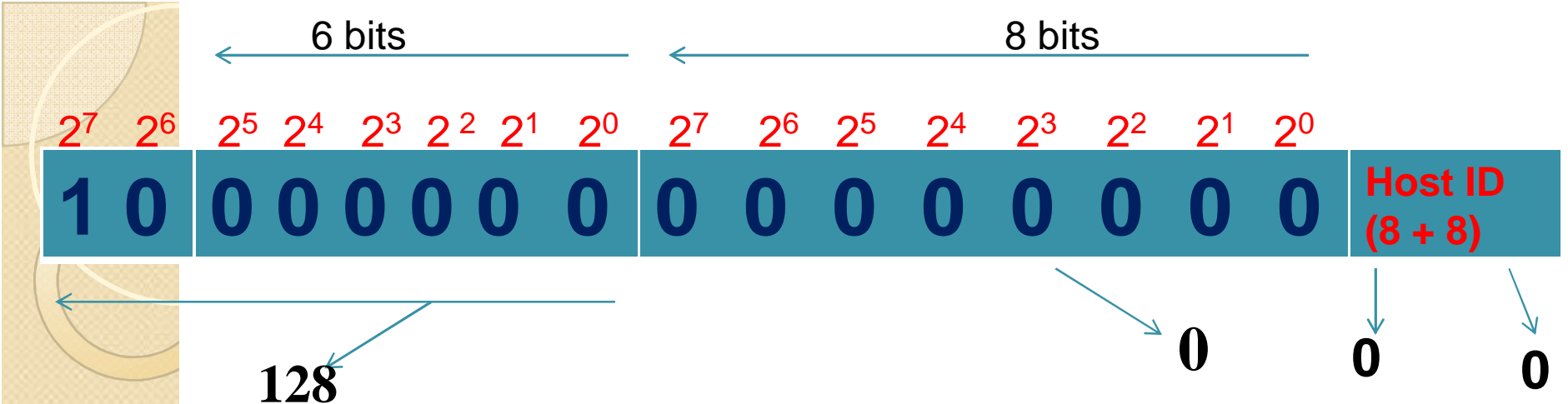
14 bits (6 + 8)

10	(6 bit) 000000	8 bit(00000000)	Host id (8 + 8)

Range from 0 to 255

Range from 0 to 255

Ranges from 128 to 191

Range from 0 to 255

Blocks in class B

180.8 is common in all addresses

180.8.0.0 Network address

180.8.0.1

180.8.0.2

180.8.17.9

180.8.255.254

180.8.255.255 (Special)

Class B

Netid 128.0

128.0.0.0
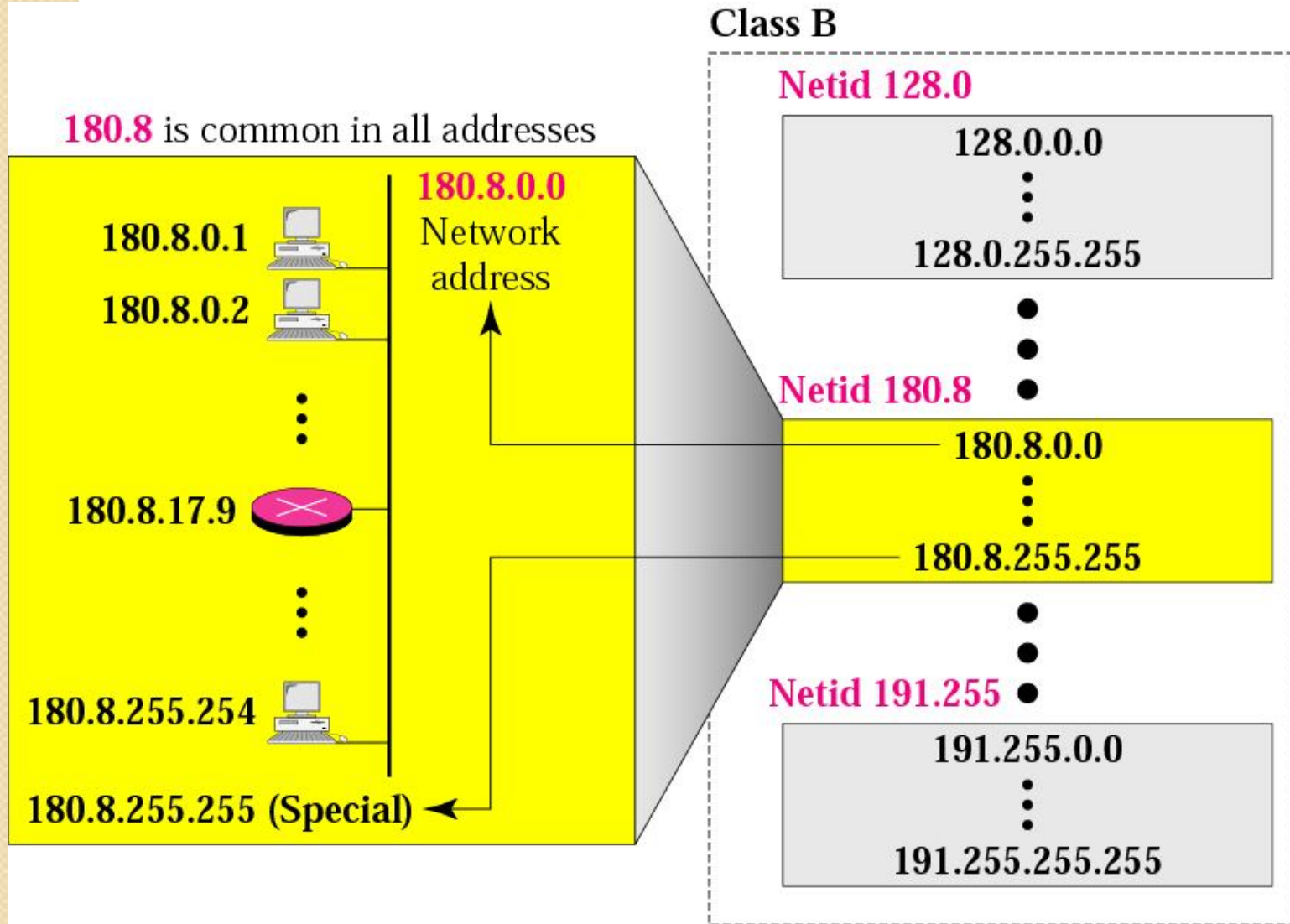⋮
128.0.255.255

Netid 180.8

180.8.0.0
⋮
180.8.255.255

Netid 191.255

191.255.0.0
⋮
191.255.255.255

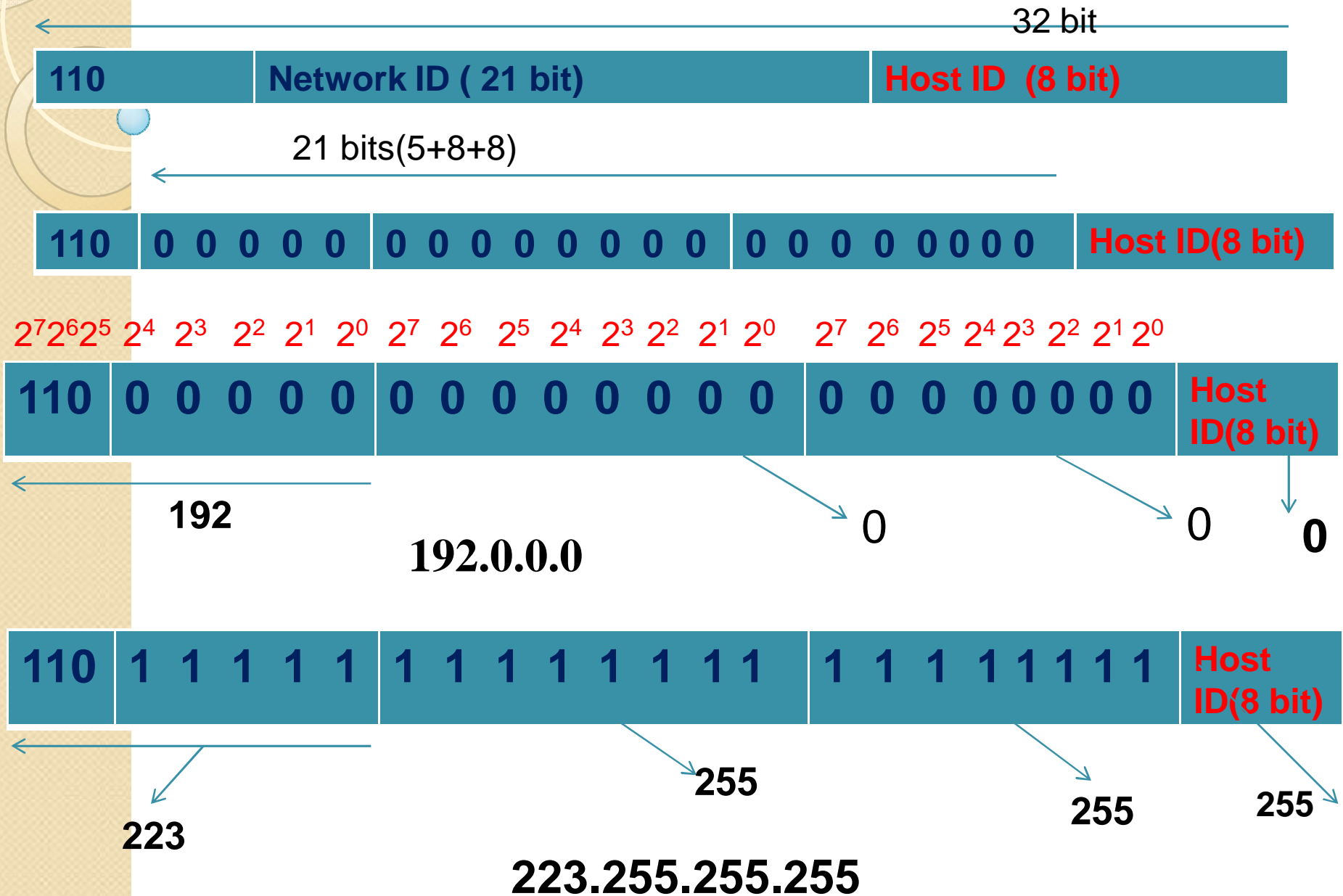16,384 blocks: 65,536 addresses in each block

Class B Addresses

- Class B divided in to 16384 blocks.
- We can assign B class addresses to 16384 org.'s, each having 65536 nodes.
- Each block has different netid. First block covers address from **128.0**.0.0 to **128.0**.255.255. Here netid is **128.0**.
- 2nd block covers from **128.1**.0.0 to **128.1**.255.255 with netid as **128.1.**
- Last block covers addresses from **191.255**.0.0 to **191.255**.255.255 with netid as **191.255**.
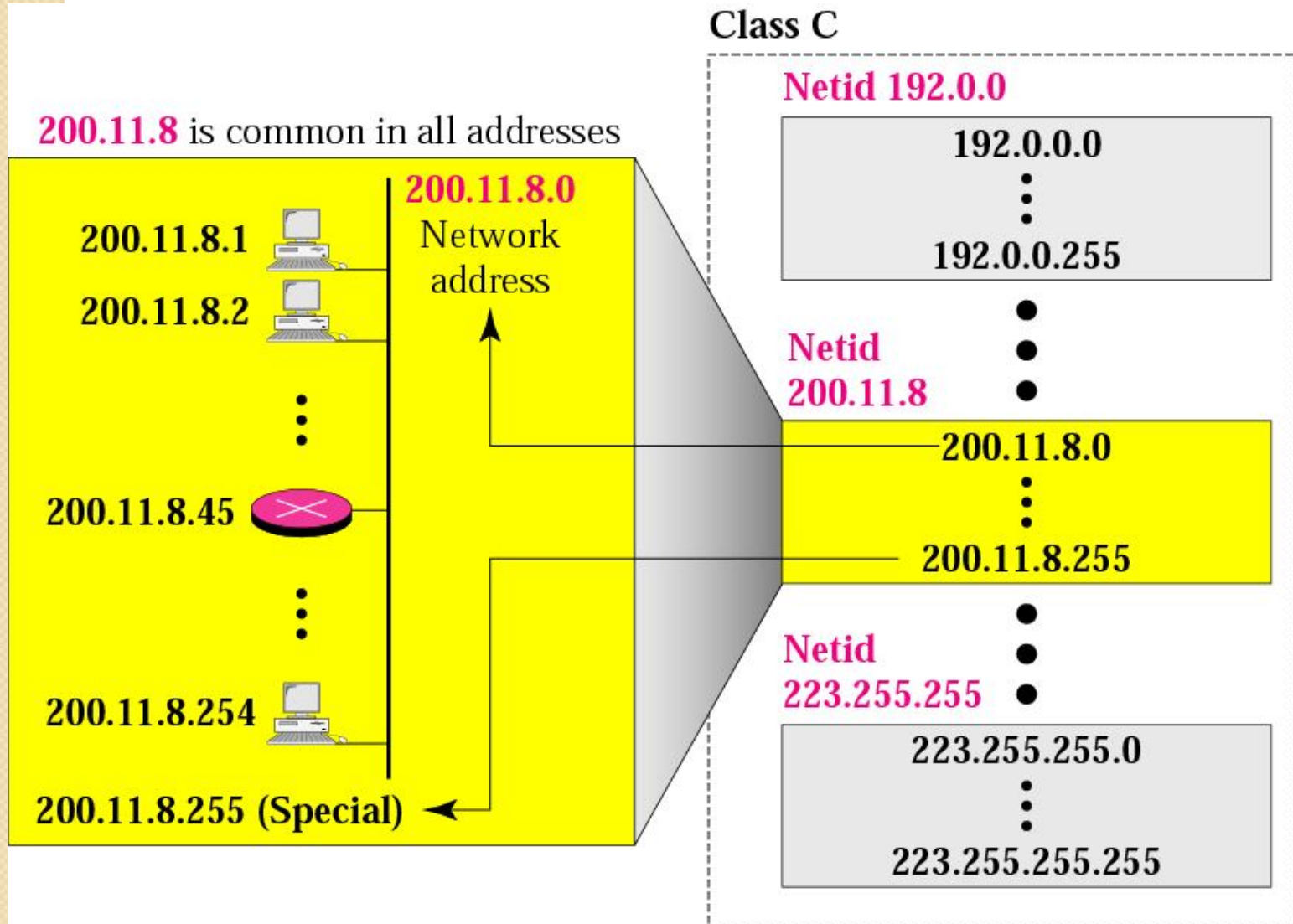- **Class B address are assigned to middle size org. having a large no's of nodes .**

Note

Many class B addresses
are wasted.

Class C address

32 bit

110	Network ID (21 bit)	Host ID (8 bit)

21 bits(5+8+8)

110	0 0 0 0 0	0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0	Host ID(8 bit)

$2^7 2^6 2^5$ 2^4 2^3 2^2 2^1 2^0 2^7 2^6 2^5 2^4 2^3 2^2 2^1 2^0 2^7 2^6 2^5 2^4 2^3 2^2 2^1 2^0

110	0 0 0 0 0	0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0	Host ID(8 bit)

192

0

0

0

192.0.0.0

110	1 1 1 1 1	1 1 1 1 1 1 1 1	1 1 1 1 1 1 1 1	Host ID(8 bit)

223

255

255

255

223.255.255.255

Blocks in class C

Class C

Netid 192.0.0

192.0.0.0
⋮
192.0.0.255

Netid 200.11.8

200.11.8.0
⋮
200.11.8.255

Netid 223.255.255

223.255.255.0
⋮
223.255.255.255

200.11.8 is common in all addresses

200.11.8.0 Network address

200.11.8.1

200.11.8.2

200.11.8.45

200.11.8.254

200.11.8.255 (Special)

2,097,152 blocks: 256 addresses in each block

Class C Addresses

- Class C divided in to 2,097,152 blocks.

- We can assign C class addresses to 2,097,152 org.'s. each having 256 nodes.

- First block covers address from **192.0.0**.0 to **192.0.0**.255. here netid is **192.0.0**

- Last block covers addresses from **223.255.255**.0 to **223.255.255**.255 with netid as **223.255.255**.

- Class C address are assigned to small size org. having a less no's of nodes .

To be continued