SNS COLLEGE OF TECHNOLOGY

Coimbatore-35
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DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

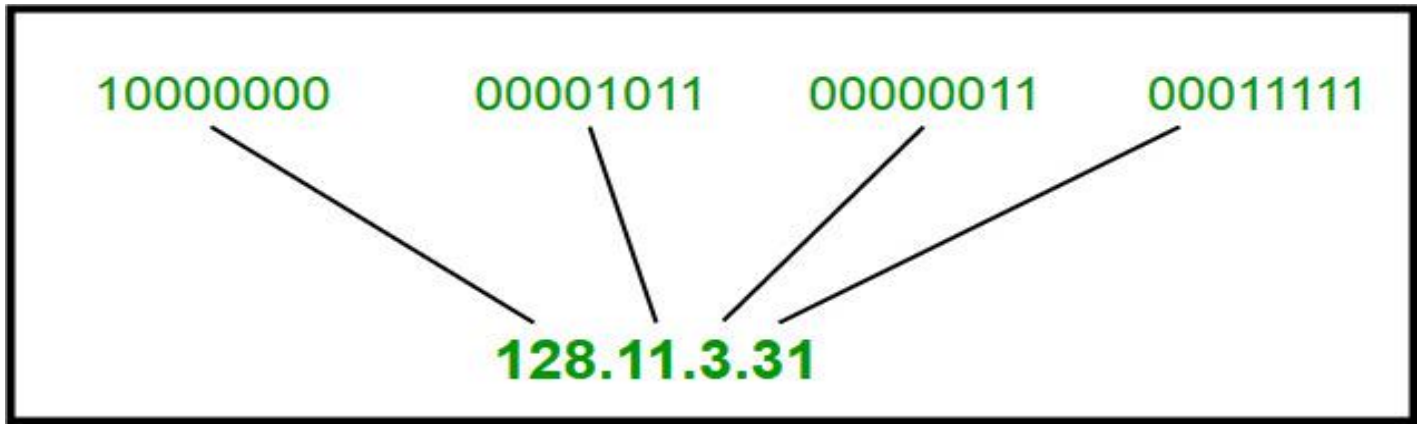
19CSB302- COMPUTER NETWORKS

UNIT-3 INTERNETWORKING AND ROUTING

IP ADDRESSING

An IP address is an address having information about how to reach a specific host, especially outside the LAN. An IP address is a 32-bit unique address having an address space of 2^{32}.

DOTTED DECIMAL /BINARY NOTATION



CLASSFUL ADDRESSING

The 32-bit IP address is divided into five sub-classes.

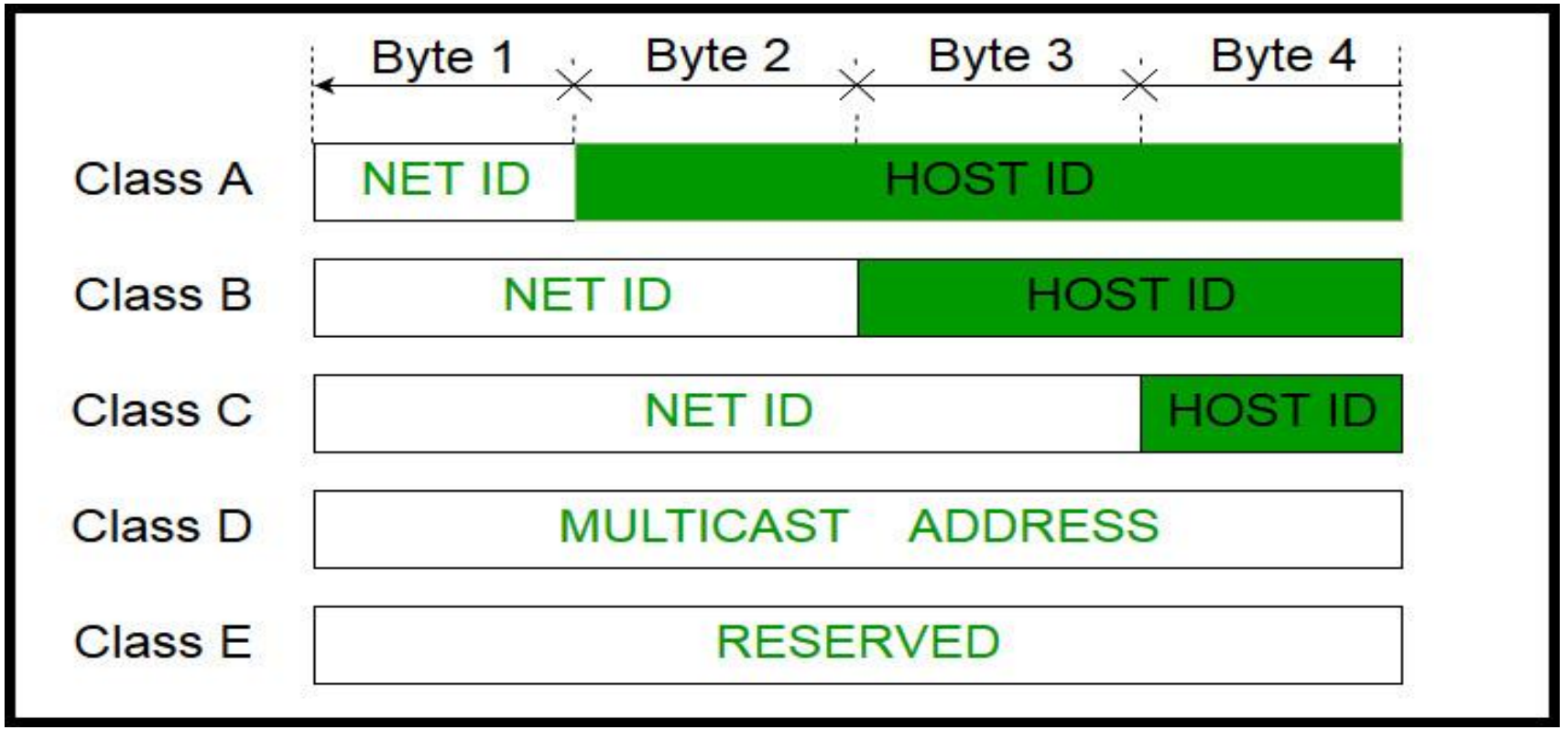
- Class A
- Class B
- Class C
- Class D
- Class E

Each of these classes has a valid range of IP addresses. Classes D and E are reserved for multicast and experimental purposes respectively. The order of bits in the first octet determines the classes of the IP address.

The IPv4 address is divided into two parts:

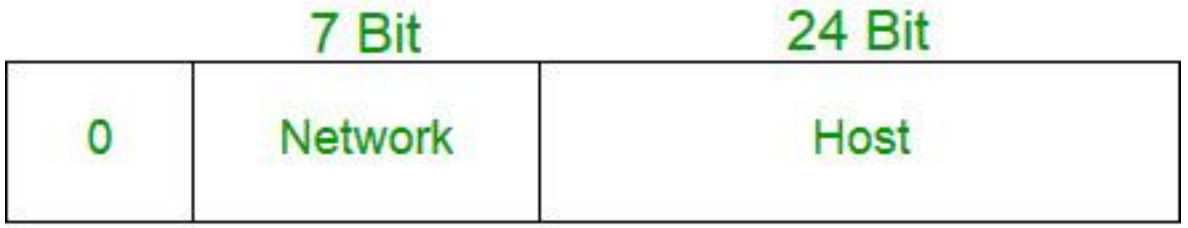
- Network ID
- Host ID

The class of IP address is used to determine the bits used for network ID and host ID and the number of total networks and hosts possible in that particular class. Each ISP or network administrator assigns an IP address to each device that is connected to its network.


Byte 1
Byte 2
Byte 3
Byte 4
Class A
NET ID
HOST ID
Class B
NET ID
HOST ID
Class C
NET ID
HOST ID
Class D
MULTICAST ADDRESS
Class E
RESERVED

Class A

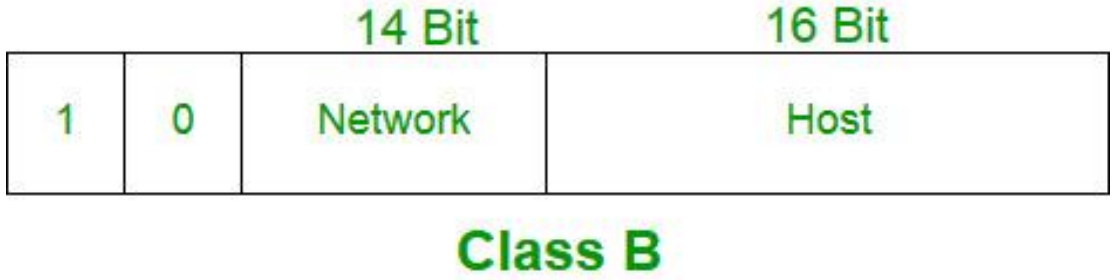
- IP addresses belonging to class A are assigned to the networks that contain a large number of hosts.
- The network ID is 8 bits long.
- The host ID is 24 bits long. The higher-order bit of the first octet in class A is always set to 0. The remaining 7 bits in the first octet are used to determine network ID. The 24 bits of host ID are used to determine the host in any network.



Class A

Class B

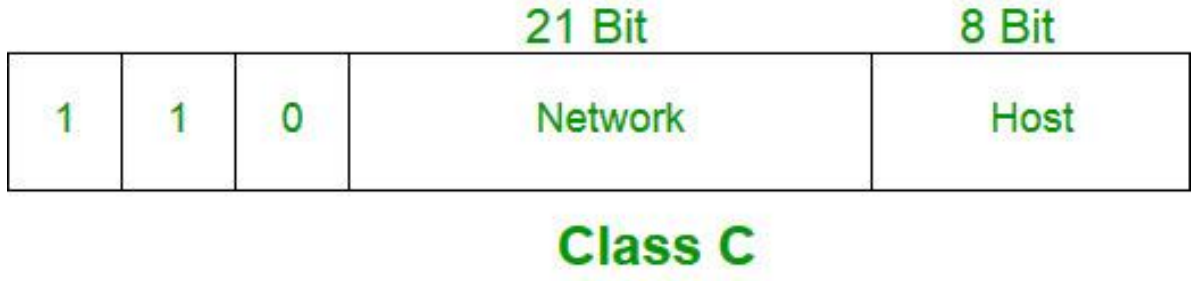
- IP address belonging to class B is assigned to networks that range from medium-sized to large-sized networks.
- The network ID is 16 bits long.
- The host ID is 16 bits long.
- The higher-order bits of the first octet of IP addresses of class B are always set to 10. The remaining 14 bits are used to determine the network ID. The 16 bits of host ID are used to determine the host in any network.



Class B

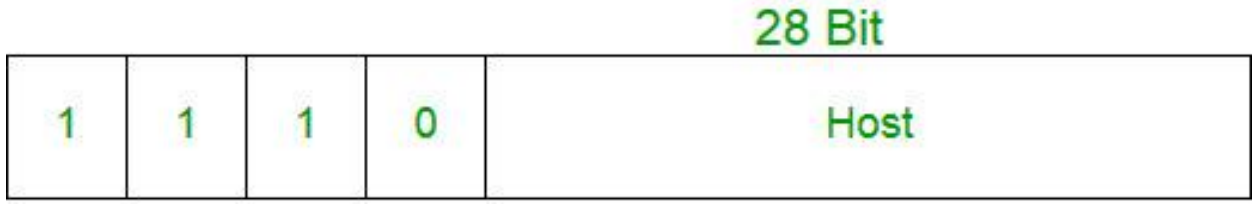
Class C

- IP addresses belonging to class C are assigned to small-sized networks.
- The network ID is 24 bits long.
- The host ID is 8 bits long.
- The higher-order bits of the first octet of IP addresses of class C is always set to 110. The remaining 21 bits are used to determine the network ID. The 8 bits of host ID are used to determine the host in any network



Class D

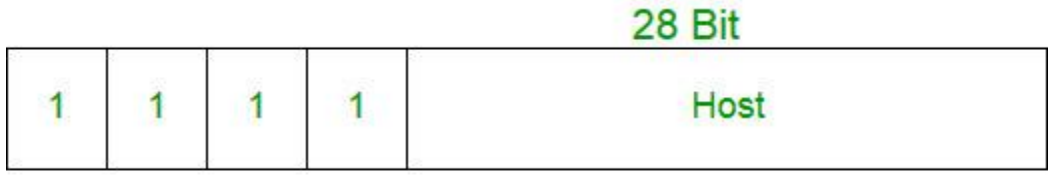
- IP address belonging to class D is reserved for multi-casting. The higher-order bits of the first octet of IP addresses belonging to class D is always set to 1110.



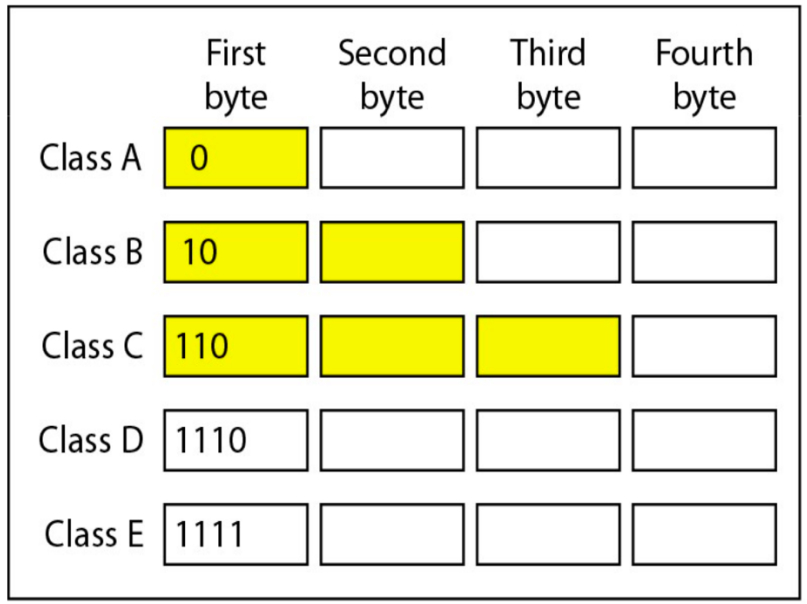
Class D

Class E

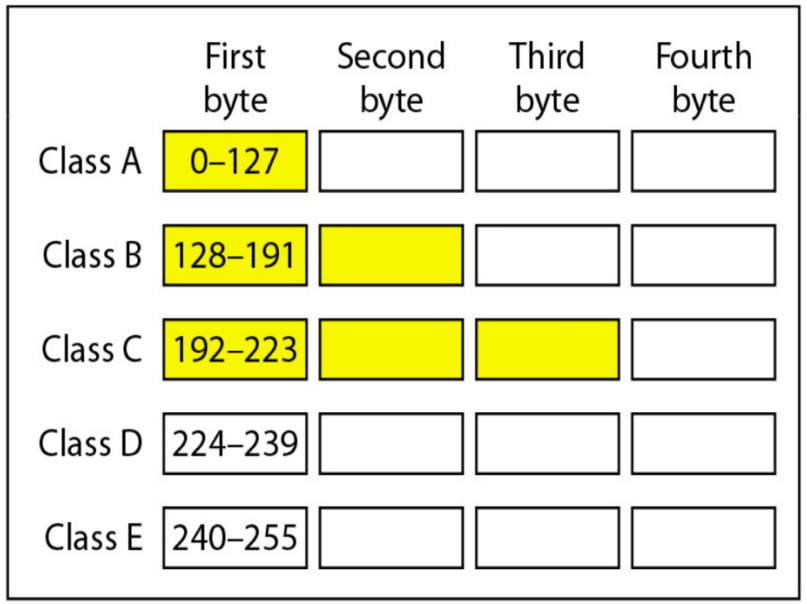
- IP addresses belonging to class E are reserved for experimental and research purposes.



Class E



a. Binary notation



b. Dotted-decimal notation

Subnet Mask

- When you connect a device to a network, the network assigns an IP address to the device. That IP address consists of two parts: the **network portion** and the **host portion**. The network portion of the IP address identifies the overall network while the host portion identifies the device. The subnet mask is obtained by making all the network bits 1 and host bits 0.

Class A
Subnet Mask

Netwok	Host	Host	Host
255	0	0	0

Class B
Subnet Mask

Netwok	Network	Host	Host
255	255	0	0

Class C
Subnet Mask

Netwok	Network	Network	Host
255	255	255	0

Classes of IPv4 address

Address Class	1st Octet range in decimal	1st Octet bits (Blue Dots do not change)	Network (N) and Host (H) Portion	Default mask (Decimal)	Number of possible networks and hosts per network
A	0–127	00000000 - 01111111	N.H.H.H	255.0.0.0	128 Nets (2^7) 16,777,214 hosts ($2^{24}-2$)
B	128–191	10000000 - 10111111	N.N.H.H	255.255.0.0	16,384 Nets (2^{14}) 65,534 hosts ($2^{16}-2$)
C	192–223	11000000 - 11011111	N.N.N.H	255.255.255.0	2,09,150 Nets (2^{21}) 254 hosts (2^8-2)
D	224–239	11100000 - 11101111	NA (Multicast)	-	-
E	240–255	11110000 - 11111111	NA (Experimental)	-	-

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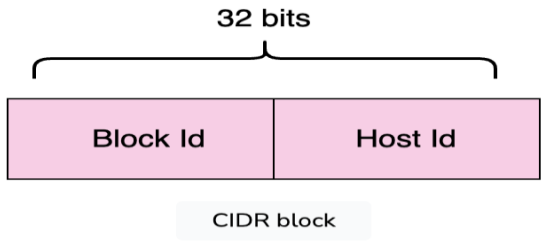
In Classful addressing, a large part of available addresses were wasted

Classless Addressing

- **Classless Inter-Domain Routing (CIDR)** is another name for classless addressing.
- This addressing type aids in the more efficient allocation of IP addresses.
- This technique assigns a block of IP addresses based on specified conditions when the user demands a specific amount of IP addresses. This block is known as a "CIDR block", and it contains the necessary number of IP addresses.

Structure

The CIDR block comprises two parts. These are as follows:



Block id is used for the network identification

Host id is used to identify the host part of the network.

Notation

CIDR IP addresses look as follows:

w.x.y.z/n

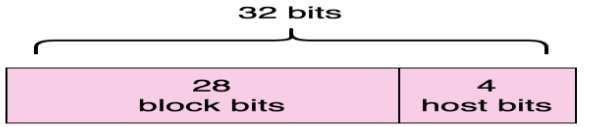
- In the example above *w*,*x*,*y*,*z* each defines an 8-bit binary number, while *n* tells us about the number of bits used to identify the network and is called an **IP network prefix** or **mask**.

Rules

- Addresses should be contiguous.
- The number of addresses in the block must be in the power of 2.
- The first address in the block can be found by setting the rightmost 32-n bits to 0s
- The last address in the block can be found by setting the rightmost 32-n bits to 1s

Given the following IP address, let's find the network and host bits.

- 200.56.23.41/28



CIDR block with block and host ids' bits

- $n_h=2^{32-n}$
- This particular case, in which *n* equals 28, represents the block id bits, so subtracting it with 32 leaves us with the total number of hosts expected in the network.
- $n_h=2^{32-28}$
- $n_h=2^4$

Therefore there are 16 hosts in this network

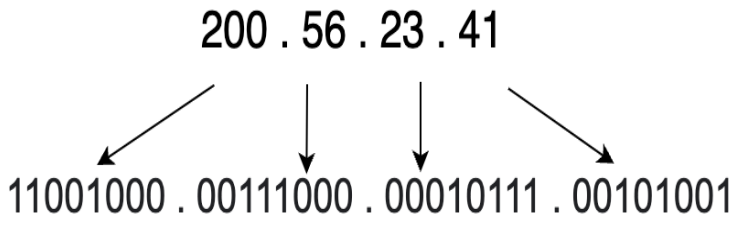
Subnet Mask

- The 32-bit IP address contains information about the host and its network. It is very necessary to distinguish both. For this, routers use Subnet Mask, which is as long as the size of the network address in the IP address. Subnet Mask is also 32 bits long. If the IP address in binary is ANDed with its Subnet Mask, the result yields the Network address.

Network address

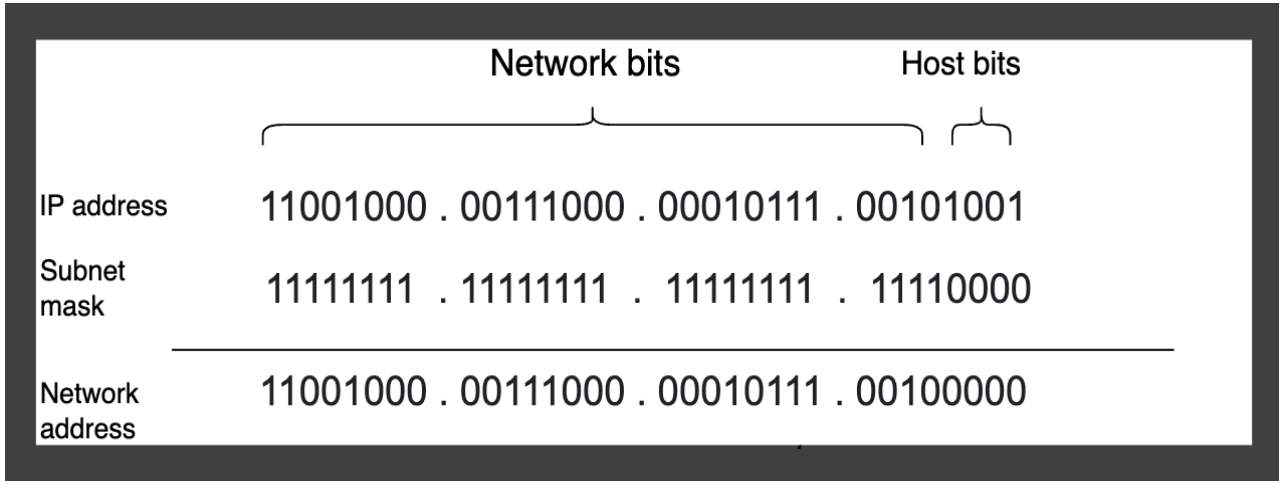
- To find the network address of a particular IP address, apply the AND operation to the IP address with its subnet mask. The subnet mask is obtained by making all the network bits 1 and host bits 0.

- To obtain the network address of the classless IP address 200.56.23.41/28, the following steps are needed:
- Convert the address into binary notation, as follows:



IP address into binary notation

Now apply the AND operation on the converted IP address and its subnet mask. The resultant will be the network address in binary format.



Convert the network address into decimal.