



Introduction to Subnetting

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Basic Structure of IP Address



SUBNETTING

Basic Structure of IP Address:

An IP address is an address used in order to uniquely identify a network interface on a machine on an IP network. The address is made up of 32 binary bits, which can be divisible into a network portion and host portion with the help of a subnet mask. The 32 binary bits are broken into four octets (1 octet = 8 bits). Each octet is converted to decimal and separated by a period (dot). For this reason, an IP address is said to be expressed in dotted decimal format (for example, 129.16.10.100). The value in each octet ranges from 0 to 255 decimal, or 00000000 - 11111111 binary. The bytes of the IP address are further classified into two parts: the network part and the host part. Figure 1 shows the component parts of a typical IP address, 172.16.10.100.

Decimal	172 .	16 .	10 .	100
:				
Binary	10101100.	00010000.	00001010.	01100100
:				
	Network Bit		Host Bit	

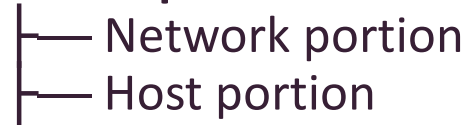
Difference between Physical Network and IP Network

Physical Network	IP Network
Group of the physical hardware parts that make up a network, including cables & routers.	Group of computers connected via their unique Internet Protocol (IP) addresses.
Two types: <ul style="list-style-type: none">- LAN- WAN	Three types: <ul style="list-style-type: none">- Host address- Network address- Broadcast address
Physically connected	Physically not connected
Big in size & hardware type	Comparatively small size & software type

IP Address

- IP address is a **32-bit** address that consists of two components:

→ **Two components**



- A horizontal line with a vertical tick mark in the middle. Above the line, a bracket spans the entire length, and another bracket spans the right half, starting from the middle tick mark.
- | Network bits | Host bits |
- A horizontal line with a vertical tick mark in the middle. Below the line, a bracket spans the entire length, and another bracket spans the right half, starting from the middle tick mark.
- ←— 32 bit —→
- IP address
- The network bits make up the left portion of the address.
- The host bits make up the right portion of the address.

IP address Class

Network Masks and IP Address Class:

A network mask helps to identify the network and host portion of the IP address. Class A, B, and C networks have default masks, also known as natural masks, as shown here:

Class	Address Range	Supports	Default Mask
Class A	1.0.0.1 -126.255.255.254	Supports 16 million hosts on each of 127 networks.	255.0.0.0
Class B	128.1.0.1-191.255.255.254	Supports 65,000 hosts on each of 16,000 networks.	255.255.0.0
Class C	192.0.1.1 - 223.255.254.254	Supports 254 hosts on each of 2 million networks.	255.255.255.0
Class D	224.0.0.0 - 239.255.255.255	Reserved for multicast groups.	
Class E	240.0.0.0 - 254.255.255.254	Reserved for future use/research/development	

Any address that has not been subnetted would have an address/mask

Introduction to IP Addressing

- *(helps to know physical location)*

IP Address

- → IPv4 (4 octets) / 32 bits
- → IPv6 (16 octets) / 128 bits

•A ↔ B

- 32 bits
- 4 octets
- 0-255
- 5 classes
- Network / Host

00000000 . 11111111

IP Address Classes

- Class A → N | H | H | H
- Class B → N | N | H | H
- Class C → N | N | N | H
- Class D → Multicasting
- Class E → Reserved for research

IPv4	IPv6
32-bit address	128-bit address
Consists of 4 (8-bit) octets, which are separated by dots (.)	Consists of 16 (8-bit) octets, which are separated by colons (:))
It has 5 different classes: Class A, Class B, Class C, Class D & Class E	It does not contain classes
Limited number of IP addresses	Large number of IP addresses
It supports VLSM (Variable Length Subnet Mask)	It does not support VLSM
Represented in decimal	Represented in hexadecimal
Fragmentation is done by the sender & the forwarding routers	Fragmentation is done by the sender only
Checksum field is available	Checksum field is not available
It does not provide encryption & authentication	It provides encryption & authentication

- Notation of IP address
- IP range of different classes

Class Name	Octets	Range
Class A	0xxxxxxx H H H	1.0.0.0 to 126.255.255.255
Class B	10xxxxxx N H H	128.0.0.0 to 191.255.255.255
Class C	110xxxxx N N H	192.0.0.0 to 223.255.255.255

H represents the Host portion.

N represents the Network portion.

The first network ID bit differentiates the class:

Class A: 0xxxxxxx → 1 to 126

Class B: 10xxxxxx → 128 to 191

Class C: 110xxxxx → 192 to 223

Class A

| N | H | H | H |

7 bit (Network)

24 bit (Host)

Network ID = $2^7 - 2 = 126$

Host ID = $2^{24} - 2 = 16,777,214$

Class B

| 10 | N | N | H | H |

6 + 8 = 14 bits (Network)

16 bit (Host)

Network ID = $2^{14} = 16,384$

Host ID = $2^{16} - 2 = 65,534$

Class C

| 110 | N | N | N | H |

21 bit (Network)

8 bit (Host)

Network ID = $2^{21} = 2,097,152$

Host ID = $2^8 - 2 = 254$