

IP Address Classification and Subnet Masks

IPv4 Address Classes (Simplified)

Class	Network Bits	Host Bits	Address Range
A	8	24	1.0.0.0 – 126.255.255.255
B	16	16	128.0.0.0 – 191.255.255.255
C	24	8	192.0.0.0 – 223.255.255.255

Network and Host Bits



IPv4 Address Classes (Detailed)

Class	Leading Bits	Network Bits	Remaining Bits	Number of Networks	Hosts Per Network	Default Subnet Mask
Class A	0 (1-126)	8	24	128 (2^7)	16,777,216 (2^{24})	255.0.0.0
Class B	10 (128-191)	16	16	16,384 (2^{14})	65,536 (2^{16})	255.255.0.0
Class C	110 (192-223)	24	8	2,097,152 (2^{21})	256 (2^8)	255.255.255.0
Class D (multicast)	1110 (224-239)	Not Defined	Not Defined	Not Defined	Not Defined	Not Defined
Class E (reserved)	1111 (240-255)	Not Defined	Not Defined	Not Defined	Not Defined	Not Defined

Default Subnet Masks

- The Subnet Mask tells you which portion of the IP address identifies the network and which portion identifies the host.
- Below are default Class A, B, and C Subnet Masks.

	8 bits	8 bits	8 bits	8 bits
Class A:	Network	Host	Host	Host
IP Address	10.	0.	0.	15
Subnet Mask	11111111.	00000000.	00000000.	00000000
	255.	0.	0.	0

	Network	Network	Host	Host
Class B:				
IP Address	172.	16.	0	.110
Subnet Mask	11111111.	11111111.	00000000.	00000000
	255.	255.	0.	0

	Network	Network	Network	Host
Class C:				
IP Address	192.	168.	1.	50
Subnet Mask	11111111.	11111111.	11111111.	00000000
	255.	255.	255.	0

Let's Practice

What class are the following IP Addresses?

- **IP Address:** 9.10.40.15
- **Subnet Mask:** 255.0.0.0

- **IP Address:** 135.240.110.100
- **Subnet Mask:** 255.255.0.0

- **IP Address:** 196.200.10.5
- **Subnet Mask:** 255.255.255.0

CIDR Notation

- **CIDR:** Classless Inter-Domain Routing
 - A methodology for subnetting
 - “Slash” Notation tells you how many bits are associated with the Subnet Mask
- A shortcut way of telling us what the Subnet Mask is:
 - /8 = 11111111.00000000.00000000.00000000
 - /8 = 255.0.0.0
- 192.168.1.0 /24 = 255.255.255.0
- 10.1.0.0 /16 = 255.255.0.0
- 196.10.10.0/25 = 255.255.255.128

The Power of 2's

Understanding the Power of 2

- We use the power of 2 in IP addressing and subnetting.
- It's important to memorize the power of 2.

$2^1 = 2$	$2^2 = 4$	$2^3 = 8$	$2^4 = 16$
$2^5 = 32$	$2^6 = 64$	$2^7 = 128$	$2^8 = 256$
$2^9 = 512$	$2^{10} = 1,024$	$2^{11} = 2,048$	$2^{12} = 4,096$

Using Power of 2 to Determine Network Hosts

	8 bits	8 bits	8 bits	8 bits
Class A:	Network = 8 Bits	Hosts = 24 Bits = $2^{24} - 2 = 16,777,214$		
Class B:	Network = 16 Bits		Hosts = 16 Bits = $2^{16} - 2 = 65,534$	
Class C:	Network = 24 Bits			Hosts = 8 Bits = $2^8 - 2 = 254$

- **Hosts Per Network** = $2^h - 2$, where h is the number of host bits available.
- We subtract two because each network includes a **network address** and **broadcast address** that are not available for use by network end devices.

Public versus Private IP Addresses

Public versus Private IP Addresses

Public IP Addresses

- Original Design of Internet
- “Registered” Public IP Addresses
- Assigned by an ISP to a Business or Home
- Must be Globally Unique
 - Web Servers
 - DNS Servers
 - Routers
- By the Early 1990s, the World was Running out of Public IP Addresses
- Private IP Addresses & Network Address Translation (NAT) were Born!

Private IP Addresses

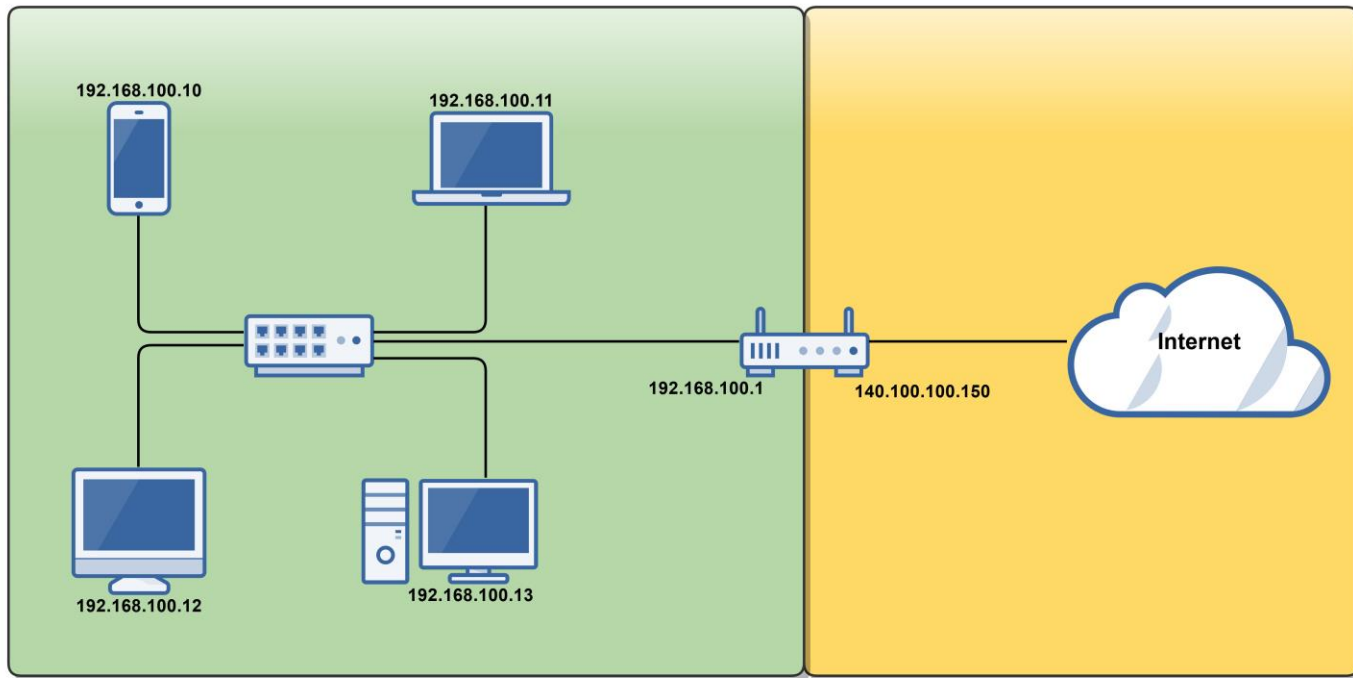
- “Unregistered” – Free for Use by Anybody!
- Designed for Use within Private Internal Networks
- Can Be Used Over and Over Again
- Cannot be Used or Routed on a Public Network
- Utilizes NAT to “Speak” to Public Networks, i.e., the Internet!

Private IP Address Ranges

Class	IP Address Range	Network ID(s) (CIDR Notation)	Number of Addresses
A	10.0.0.0 – 10.255.255.255	10.0.0.0 /8 • 1 Private Class A Network	16,777,216 IP Addresses Per Network ID
B	172.16.0.0 – 172.31.255.255	172.16.0.0 – 172.31.0.0 /16 • 16 Private Class B Networks	65,534 IP Addresses Per Network ID
C	192.168.0.0 – 192.168.255.255	192.168.0.0 – 192.168.255.0 /24 • 256 Private Class C Networks	254 IP Addresses Per Network ID

Public versus Private IP Addresses Visualized

Public versus Private IP Addresses Visualized



The Loopback IP Address

The Loopback Address

- **127.0.0.0 to 127.255.255.255** is reserved for loopback, i.e., a host's own address, also known as the localhost address.
 - **127.0.0.1** is typically configured as the default loopback address on operating systems.
- Used for diagnostics purposes to check that TCP/IP is correctly installed on a host's operating system.
 - When a process creates a packet destined to the loopback address, the operating system loops it back to itself without it ever interfacing with the NIC.
 - Data sent on the loopback is forwarded by the operating system to a virtual network interface within the operating system.
- If you can successfully ping 127.0.0.1 or any IP within the loopback range, then TCP/IP on your computer is properly working.
 - Ping 127.0.0.1
 - Ping localhost
 - Ping loopback