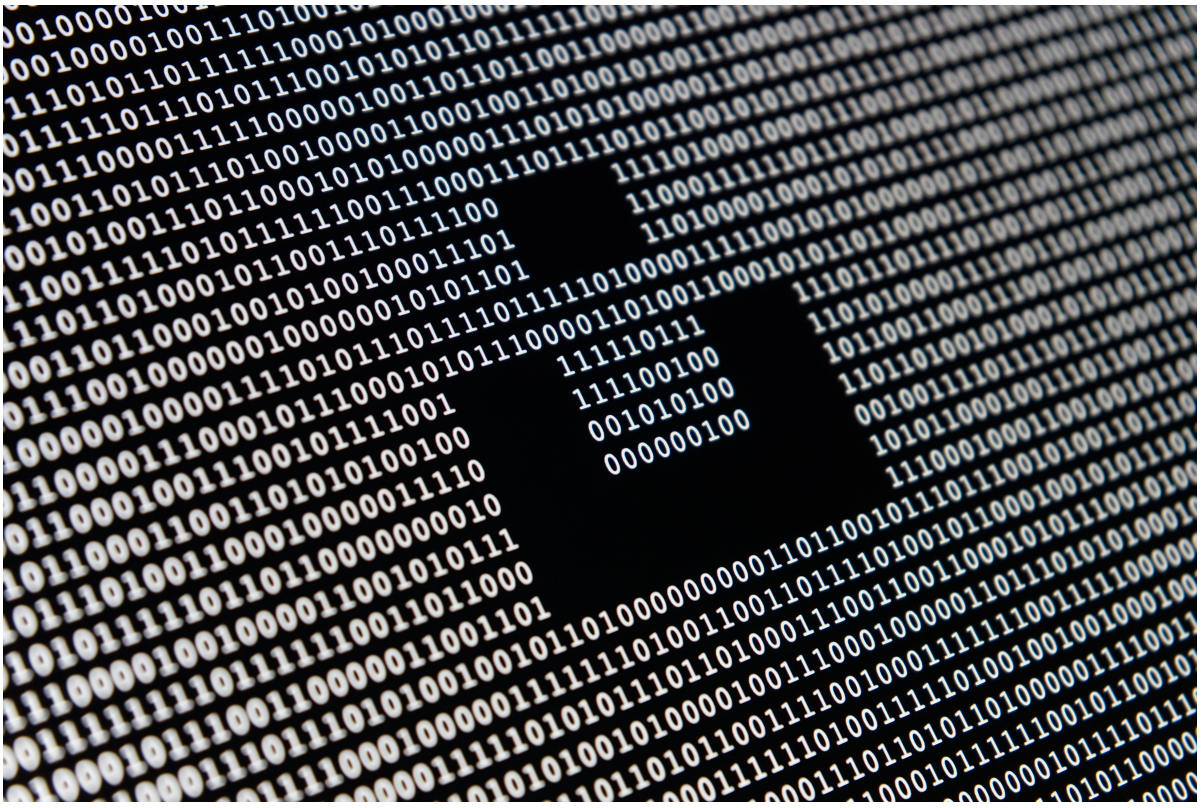
IP Address Fundamentals Worksheet

This document is designed to introduce you to the basic concepts of IP addresses, their structure, types, and functions within a computer network. After completing this worksheet, you should have a good understanding of how IP addresses work and their importance in networking.



Part 1: What is an IP Address?

An IP (Internet Protocol) address is a unique identifier assigned to each device connected to a network. It enables devices to communicate with each other by specifying the source and destination of data packets.

What does IP stand for?

Internet Protocol

Why is an IP address important?

It allows devices to identify and communicate with each other on a network by specifying where data should be sent and where it came from.

Part 2: Types of IP Addresses

There are two main types of IP addresses: **IPv4** and **IPv6**.

IPv4 Addressing

IPv4 addresses are 32-bit numbers that are typically written as four decimal numbers separated by periods. For example, `192.168.1.1`.

How many bits are in an IPv4 address?

32 bits

What is the range of each octet in an IPv4 address?

0 to 255

Example: Convert the binary number `11000000.10101000.00000001.00000001` to its decimal form.
Answer: 192.168.1.1

Structure of an IPv4 Address

An IPv4 address is made up of four sets of numbers separated by dots, and each set is called an **octet**. Each octet can range from 0 to 255.

Example: `192.168.1.10`

- First octet: 192
- Second octet: 168
- Third octet: 1
- Fourth octet: 10

Breaking Down IPv4 Addresses

Break the following IP addresses into their respective octets:

1. 10.0.0.5
    - First octet: __
    - Second octet: __
    - Third octet: __
    - Fourth octet: __
2. 172.16.254.1
    - First octet: __
    - Second octet: __
    - Third octet: __
    - Fourth octet: __

IPv4 Address Classes

IPv4 addresses are categorised into five different classes (A, B, C, D, and E), with each class having a specific range of addresses. The classes A, B, and C are commonly used for network devices.

Class	Range (First Octet)	Default Subnet Mask	Number of Hosts Supported	Usage
Class A	1 - 126	255.0.0.0	16,777,214	Large networks
Class B	128 - 191	255.255.0.0	65,534	Medium-sized networks
Class C	192 - 223	255.255.255.0	254	Small networks
Class D	224 - 239	Reserved for special purposes		Multicasting
Class E	240 - 255	Reserved for special purposes		Experimental

Note: Class A allows for more devices on a network than Class C, as it uses fewer bits for the network portion and more for the host portion.

IPv6 Addressing

IPv6 addresses are 128-bit numbers written as eight groups of four hexadecimal digits separated by colons. For example, `2001:0db8:85a3:0000:0000:8a2e:0370:7334`.

How many bits are in an IPv6 address?

128 bits

What is the primary reason for the development of IPv6?

To provide a much larger address space than IPv4, which is necessary due to the growing number of devices connected to the internet.

Part 3: Public vs. Private IP Addresses

IP addresses can be either **public** (accessible over the internet) or **private** (used within a local "private" network).

Private IP Address Ranges:

- Class A: `10.0.0.0` to `10.255.255.255`
- Class B: `172.16.0.0` to `172.31.255.255`
- Class C: `192.168.0.0` to `192.168.255.255`

Why are private IP addresses important?

Private IP addresses allow multiple devices to connect to a local network without using up public IP address space. These addresses cannot be accessed directly from the internet, providing a layer of security.

Part 4: Subnetting

Subnetting is the process of dividing a larger network into smaller, more manageable sub-networks (subnets). This helps in better network management and security.

What is the purpose of subnetting?

To divide a network into smaller sub-networks for better organisation, security, and efficient use of IP addresses.

Example Question:

Convert the following IP address into its binary form: **IP Address:** 192.168.1.100
Answer: 11000000.10101000.00000001.01100100

CIDR Notation:

CIDR (Classless Inter-Domain Routing) notation is used to denote IP addresses and their associated routing prefix. It is written as an IP address followed by a slash and a number (e.g., 192.168.1.0/24), which represents the number of bits in the network portion of the address.

Part 05: DHCP and Static IPs

- **Dynamic IP addresses** are assigned by the DHCP (Dynamic Host Configuration Protocol) server and can change over time.
- **Static IP addresses** are manually assigned and do not change.

Part 6: Loopback IP Addresses

The IP address range that starts with **127.x.x.x** is reserved for **loopback** addresses, which is why it isn't included in the regular classification system (Class A, B, C). Specifically, **127.0.0.1** is the most commonly used loopback address, and it's often referred to as the **localhost**. Here's why:

Loopback Address Explanation:

- **Purpose:** The loopback address allows a device to send network traffic to itself. It is primarily used for testing and diagnostics on the local machine.
- **Range:** The entire 127.x.x.x range (127.0.0.0 to 127.255.255.255) is reserved for this purpose. However, **127.0.0.1** is the standard loopback address used in most systems.

Why it's not included in regular IP classifications:

- **Not used for external communication:** Loopback addresses do not represent physical machines on the network. They are only for internal testing and communications within the host device.
- **Network independence:** Any traffic sent to 127.0.0.1 remains inside the local machine, so these addresses are not used for routing packets over external networks.

For these reasons, **127.x.x.x** is a special-case range and doesn't belong to any of the standard classes (A, B, or C) that are used for routing network traffic between different devices.

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