

## Overview

The **Internet Protocol** is a protocol, or set of rules, that helps define how information on the Internet is transmitted. Part of this protocol involves assigning each device on the Internet an **IP Address**, which helps to identify that device on the Internet. IP has gone through several different versions, the most recent of which is **IPv6**, which is intended to replace the existing protocol, **IPv4**.

## Key Terms

- Internet Protocol
- IP Address
- IPv6
- IPv4



**IPv4 Address #.#.#.#**↑
0-255



Under the IPv4 system, each IP address is composed of four numbers separated by decimal points. Each number is a decimal number in the range of 0 to 255 inclusive (8 bits of space). As a result, each IPv4 address is 32 bits, which means there can be at most 232 addresses under IPv4. This amounts to about 4.3 billion addresses total.

However, as the Internet has grown, 4.3 billion addresses is no longer sustainable to support all of the devices that are trying to connect to the Internet. As a result, the IPv6 standard was developed in order to add more possible IP addresses.

Under IPv6, each IP address consists of eight numbers, separated by semicolons. Each number is a 16-bit number (compared to the 8-bit numbers used in IPv4). Instead of representing each number as a decimal, IPv6 uses hexadecimal (16-bit) instead, in the range of 0000 to fffff. Since each IPv6 address stores 128 bits (8 numbers \* 16-bits), that means that there are more than 340 billion billion billion possible IP addresses. This is significantly more addresses than are currently used, so many IPv6 addresses currently include several 0s among their 8 component numbers.

As a shorthand method, IPv6 addresses can be abbreviated by cutting off any leading Os in front of hexadecimal numbers and replacing multiple consecutive component Os with a double colon (::). For instance, the IP address 28aa:0000:0000:0000:0000:0000:0018:a5b2 could be abbreviated to just 28aa::18:a5b2 by removing leading Os and replacing multiple consecutive Os with double colons. Note that there can only be one double colon per address in this abbreviated format.

## **Private IP Addresses**

Not all IP addresses are accessible on the Internet at large. Some addresses, known as private IP addresses, are set aside to be used within a particular local network. Other computers on the local network can communicate with one another via their private IP addresses, but computers outside of the network don't have access to them.

Often, devices with private IP addresses will share a single public IP address. This helps reduce the number of public IP addresses that are needed under the IPv4 standard. Certain ranges of IPv4 addresses, such as those which take the form 10.#.#, 172.16.#.# - 172.31.#.#, or 192.168.#.#, are set aside to be used specifically for private IP addresses.



The IP address **127.0.0.1** is an IP address that connects to the same machine that the user is currently using, rather than connecting to a different one. It is known as the loopback address, or the "localhost." In computers that use IPv6, this address is **0:0:0:0:0:0:0:0:1**, or **::1**. You know what they say, there's no place like **127.0.0.1**.