IPv4 (IPv4 addresses have a total of 32 bits).

Specialized IP’s:

* 127.0.0.1, loopback address: useful for troubleshooting network errors
* 169.254.xx.xx, APIPA, the backup IP when the DHCP server is down (if your computer won’t connect to the internet, check the IP - if you see 169.254, then you know its an issue with the DHCP).
  + IP addresses are either public, private, localhost, or APIPA addresses. Automatic Private IP Addressing (APIPA) is a feature of Windows-based operating systems that enables a computer to automatically assign itself an IP address when there is no DHCP server available to perform that function. When a host uses an APIPA address, it can communicate with other hosts on the same network using APIPA. Still, it cannot reach other networks or communicate with hosts who have managed to obtain a valid DHCP lease. APIPA addresses are from 169.254.1.0 to 169.254.254.255.

IP Classification

1. 1-127 Class A; subnet mask 255.0.0.0
   1. 16.7 million possible host IP addresses available for a single network
2. 128-191 Class B subnet mask 255.255.0.0
3. 192-223 Class C subnet mask 255.255.255.0
   1. 256 host IP addresses available for a single network
   2. A Class C IP address uses a 24-bit network prefix, leaving 8 bits for host addresses. In IPv4, the number of hosts on a network is calculated as 2^(number of host bits) - 2, where the subtraction of 2 accounts for the network address (all bits set to 0) and the broadcast address (all bits set to 1). So, in a Class C network, there can be up to 254 devices (hosts) on that network.
4. 224-239 Class D, no subnet mask assigned
   1. Reserved for multicast addresses
5. 240-255 Class E, no subnet mask assigned
   1. Reserved for experiments or research purposes

Private (Internal) IP’s [routable] & Public (External) IP’s [unroutable]

* Public IPs
  + Can be accessed over the internet, ***assigned to the network by the ISP***
* Private IP’s
  + Common private IP ranges are 10 (class A), 172 (class B), 192 (class C)!
  + LAN’s

This isn’t on the A+, but I brushed by these concepts and it will literally bother me so bad if I didn’t learn about it: Classful vs Classless Addressing.

* IANA, or the Internet Assigned Numbers Authority, is responsible for allocating the entire IP address space to any entity that needs a presence on the Internet (0.0.0.0 – 255.255.255.255). IANA has delegated this responsibility to five Regional Internet Registries (RIRs): ARIN, RIPE, LACNIC, AFRINIC, APNIC, which in turn allocate address space to the various corporations in their regions. There are two strategies the RIRs use to allocate IP address space: **the legacy strategy called Classful addressing, and the current strategy of Classless addressing (commonly referred to as Classless Inter-Domain Routing, or CIDR).**

The idea behind Classful address assignments was, if you were a company that …

… needed 200 IP addresses, a /24 IP address block from the Class C range would be assigned.

… needed 50,000 IP addresses, a /16 IP address block from the Class B range would be assigned.

… needed over 65,000~ IP addresses, a /8 IP address block from the Class A range would be assigned.

However, this led to a lot of wasted IP addresses. If, for instance, you only needed 300 IP addresses, a Class C would not suffice, so you would end up with a Class B and nearly 60,000 IP addresses would be wasted.

You could argue, why not simply assign two /24 blocks from the Class C range (providing 512 IP addresses)? Good point, and this frequently was done. But what if you needed 25,000 IP addresses? That would require 98 different /24 blocks from the Class C range. Instead, a single Class B was assigned — which still meant about 40,000 IP addresses were wasted.

Classful addressing evolved into what we know of as **Classless Inter-Domain Routing, or CIDR.**

With Classless Inter-Domain Routing (CIDR), IP assignments are not limited to the three classes. The whole unicast range (any IP address with a first octet of 0 – 223) can be allocated in any size block. In effect, the whole concept of IP address “classes” is done away with entirely.

Instead of requiring the IP assignment from the RIRs to be either a 255.0.0.0 or 255.255.0.0 or 255.255.255.0 block, they could be any size — and for simplicity, slash notation was adopted.

If you need 300 IP addresses … You get a /23.

If you need 500 IP addresses … You also get a /23.

If you need 1000 IP addresses … You get a /22.

If you need 25,000 IP addresses … You get a /17.

If you need 70,000 IP addresses … You get a /15.

If you need 250,000 IP addresses … You get a /14 (instead of the ~16 million IP addresses from the /8 block that would have been assigned in the Classful world).

This flexibility greatly reduces the wastage of IP addresses. The old classful system often assigned much larger blocks than necessary, leading to a significant number of unused addresses.

CIDR address assignment became standardized with the publication of RFC 1518 in 1993 and has been the norm for over 30 years.

While the concept of classful addressing is still relevant historically, it's not practically used anymore. However, some outdated protocols or devices still operate based on classful assumptions. *For example, if given the IP address 199.22.33.4, a classful device would assume it's a Class C address with a subnet mask of 255.255.255.0.*

Slash Notation: In CIDR, subnet masks are commonly represented using slash notation, where a forward slash (/) followed by a number indicates the number of bits in the network portion of the address. For example, "/24" means that the first 24 bits are for the network portion.

Determining Network Size: The number after the slash indicates how many bits are used for the network part of the address, leaving the rest for the host portion. The formula to determine the number of available hosts in a CIDR block is 2^(32 - n) - 2, where 'n' is the number after the slash.

Examples:

1. A /24 CIDR block means the first 24 bits are for the network and the remaining 8 bits are for hosts (IPv4 addresses have a total of 32 bits). This provides 2^8 (256) possible host addresses in that network.
2. A /16 CIDR block means the first 16 bits are for the network and the remaining 16 bits are for hosts, allowing for 2^16 (65,536) possible host addresses.
3. A /20 CIDR block means the first 20 bits are for the network and the remaining 12 bits are for hosts, providing 2^12 (4,096) possible host addresses.
4. In summary, subnet masks in CIDR help specify the size of a network block by indicating the number of bits used for the network portion of an IP address. This allows for flexible and efficient allocation of IP addresses, without the limitations imposed by traditional class-based addressing.