IP Address Classes

IPv4 Characteristics

- An IPv4 address is a 32-bit binary number represented as four octets (four 8-bit values). Each octet is separated by a period.
- IPv4 addresses can be represented in one of two ways:
    - Decimal (for example, 131.107.2.200). In decimal notation, each octet must be between 0 and 255.
    - Binary (for example, 10000011.01101011.00000010.11001000). In binary notation, each octet is an 8-digit number.
- The IP address includes both the network and the host address.
- Each IP address has an implied address class that can be used to infer the network portion of the address.
- The subnet mask is a 32-bit number associated with each IP address and identifies the network portion of the address. In binary form, the subnet mask is always a series of 1s followed by a series of 0s. Note that 1s and 0s are never mixed in sequence in the mask. A simple mask might be 255.255.255.0.

IP Address Range Classes

IP addresses have a default class. The address class identifies the range of IP addresses and the default subnet mask used for the range. The following table shows the default address class for each IP address range:

Class	Address Range	First Octet Range	Default Subnet Mask	Default Routing Prefix
A	1.0.0.0 to 126.255.255.255	1-126 (00000001-01111110 binary)	255.0.0.0	/8
B	128.0.0.0 to 191.255.255.255	128-191 (10000000-10111111 binary)	255.255.0.0	/16
C	192.0.0.0 to 223.255.255.255	192-223 (11000000-11011111 binary)	255.255.255.0	/24
D	224.0.0.0 to 239.255.255.255	224-239 (11100000-11101111 binary)	n/a	n/a

E	240.0.0.0 to 255.255.255.255	240-255 (11110000-1111 1111 binary)	n/a	n/a

Host Formula

Given a network address and subnet mask, you can have 2^n-2 hosts per subnet. Begin by converting the subnet mask to a binary number. Then use the formula to find the number of hosts. To find the number of valid hosts, n = the number of unmasked bits by the mask. Using this formula for the default subnet mask for an IP address, the following number of subnet addresses and hosts are available per subnet:

- There are only 128 Class A network IDs (most of these addresses are already assigned). Each Class A address gives you 16,777,214 hosts per network.
- There are 16,384 Class B network IDs. Each Class B address gives you 65,534 hosts per network.
- There are 2,097,152 Class C network IDs. Each Class C address gives you 254 hosts per network.
- Class D addresses are used for multicast groups rather than network and host IDs.
- Class E addresses are reserved for experimental use.

Special Addresses

Address	Considerations
Network	The first octet(s) in an address range is used to identify the network itself. For the network address, the host portion of the address contains all 0s. For example: ● Class A network address: 115.0.0.0 ● Class B network address: 154.90.0.0 ● Class C network address: 221.65.244.0 0.0.0.0 is the network address used by routers to specify the default route. Using a generic value reduces the number of routing table entries. Some older routers use this address as a broadcast address.

Host	The range of IP addresses available to be assigned to network hosts is identified by the subnet mask and/or the address class. For example: • For the Class A network address 115.0.0.0, the host range is 115.0.0.1 to 115.255.255.254. • For the Class B network address 154.90.0.0, the host range is 154.90.0.1 to 154.90.255.254. • For the Class C network address 221.65.244.0, the host range is 221.65.244.1 to 221.65.244.254. A special way to identify a host on a network is by setting the network portion of the address to all 0s. For example, the address 0.0.64.128 means 'host 64.128 on this network'.
Broadcast	The last address in the range is used as the broadcast address and is used to send messages to all hosts on the network. In binary form, the broadcast address has all 1s in the host portion of the address. For example, assuming the default subnet masks are used: • 115.255.255.255 is the broadcast address for network 115.0.0.0 • 154.90.255.255 is the broadcast address for network 154.90.0.0 • 221.65.244.255 is the broadcast address for network 221.65.244.0 Two other formats you might see for the broadcast address: • The broadcast address might also be designated by setting each of the network address bits to 0. For example, 0.0.255.255 is the broadcast address of a Class B address. This designation means the broadcast address for this network. • 255.255.255.255 indicates a broadcast message intended for all hosts on this network.
Local host	Addresses in the 127.0.0.0 range are reserved for the local host (in other words, this host or the host you're currently working at). The most commonly used address is 127.0.0.1, which is the loopback address.

Public vs. Private IP Addresses

Public IP addresses are globally unique and can be used on the internet. Private IP addresses are not globally unique and cannot be used on the internet. Be familiar with the following facts about private and public IP addresses:

Address Type	Considerations
Private	The following address ranges have been reserved for private use: ● 10.0.0.0 to 10.255.255.255 ● 172.16.0.0 to 172.31.255.255 ● 192.168.0.0 to 192.168.255.255 Use addresses in these ranges for private networks. Routers connected to the internet typically filter messages within these ranges and prevent them from being routed to the internet. To use these addresses on a public network (such as the internet), they must be translated into public addresses using Network Address Translation (NAT).
Public	Public IP addresses assigned to hosts must be unique. The use of public IP addresses on the internet is controlled by entities that ensure that no two organizations are given the same range of IP addresses to assign to hosts. Be aware that: ● The Internet Assigned Numbers Authority (IANA) manages the assignment of IP addresses on the internet. IANA is operated by the Internet Corporation for Assigned Names and Numbers (ICANN). ● IANA allocates blocks of IP addresses to Regional Internet Registries (RIRs). An RIR has authority for IP addresses in a specific region of the world. ● An RIR assigns a block of addresses to internet service providers (ISPs). ● An ISP assigns one or more IP addresses to individual computers or organizations connected to the internet.