5.1.2 IP Address Facts

IP Addresses

IP addresses allow hosts to participate on IP-based networks. The following are important things to know about IP addresses:

- An IP address is a 32-bit binary number represented as four octets (four 8-bit numbers). Each octet is separated by a period.
- IP addresses can be represented two different ways:
  - Decimal (e.g., 131.107.2.200). In decimal notation, each octet must be between 0 and 255.
  - Binary (e.g., 10000011.01101011.00000010.11001000). In binary notation, each octet is an 8-character number.
- To convert from binary to decimal, memorize the decimal equivalent to the following binary numbers:

10000000	01000000	00100000	00010000	00001000	00000100	00000010	00000001
128	64	32	16	8	4	2	1

  Add together the decimal values of each bit position with a 1 value. For example, the decimal equivalent of 10010101 is:
  128 + 16 + 4 + 1 = 149
- The IP address includes both the network and the host address.
- A subnet mask is a 32-bit number associated with an IP address that 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 (1s and 0s are never mixed in sequence in the mask). A simple mask might be 255.255.255.0 (i.e., 11111111.11111111.11111111.00000000).
- 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
A	1.0.0.0 to 126.255.255.255	1–126 (00000001–01111110 binary)	255.0.0.0
B	128.0.0.0 to 191.255.255.255	128–191 (10000000–10111111 binary)	255.255.0.0
C	192.0.0.0 to 223.255.255.255	192–223 (11000000–11011111 binary)	255.255.255.0
D	224.0.0.0 to 239.255.255.255	224–239 (11100000–11101111 binary)	n/a
E	240.0.0.0 to 255.255.255.255	240–255 (11110000–11111111 binary)	n/a

- When using the default subnet mask for an IP address, you have the following number of subnet addresses and hosts per subnet:
  - There are only 126 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 Considerations

As you are assigning IP addresses to hosts, think of the following special considerations:

Address	Consideration
Network	The first address 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
Broadcast	The last address in the range is the broadcast address, and it 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

	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."
Host Addresses	When you are assigning IP addresses to hosts, understand the following: ▪ Each host must have a unique IP address. ▪ Each host on the same network must have an IP address with a common network portion of the address. You must use the same subnet mask when configuring addresses for hosts on the same network. The range of IP addresses available for network hosts is identified by the subnet mask and/or the address class. When assigning IP addresses to hosts, be aware that you cannot use the first or last addresses in the range (these are reserved for the network and broadcast addresses respectively). 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. Another way to identify a host on a network is to set the network portion of the address to all 0s. For example, the address 0.0.64.128 means "host 64.128 on this network."
Local Host	Addresses in the 127.0.0.0 range are reserved to refer to the local host (the host you're currently working at). The most commonly used address is 127.0.0.1, which is the loopback address.

Because IP addresses assigned to hosts must be unique, the use of IP addresses on the internet is controlled by organizations that ensure that every organization is given its own range of IP addresses to assign to hosts:

- 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 over IP addresses in a specific region of the world.
- An RIR assigns blocks of addresses to Internet Service Providers (ISPs).
- An ISP assigns one or more IP addresses to individual computers or organizations connected to the Internet.