12.3.2 IPv6 Facts

IP version 6 (IPv6) is an updated version of the IP protocol designed to address the shortage of registered IPv4 addresses. The IPv6 address is a 128-bit binary number. A sample IPv6 IP address looks like: 35BC:FA77:4898:DAFC:200C:FBBC:A007:8973.

This lesson covers the following topics:

- IPv6 address features
- IPv6 address components
- Types of IPv6 addresses

IPv6 Address Features

The following list describes the features of an IPv6 address:

- The address is made up of 32 hexadecimal numbers, organized into 8 quartets.
- The quartets are separated by colons.
- Each quartet is represented as a hexadecimal number between 0 and FFFF. Each quartet represents 16-bits of data (FFFF = 1111 1111 1111 1111).
- Leading zeros can be omitted in each section. For example, the quartet 0284 could also be represented by 284.
- Addresses with consecutive zeros can be expressed more concisely by substituting a double-colon for the group of zeros. For example:
  - FEC0:0:0:0:78CD:1283:F398:23AB
  - FEC0::78CD:1283:F398:23AB (concise form)
- If an address has more than one consecutive location where one or more quartets are all zeros, only one location can be abbreviated. For example, FEC2:0:0:0:78CA:0:0:23AB could be abbreviated as:
  - FEC2::78CA:0:0:23AB or
  - FEC2:0:0:0:78CA::23AB

  But *not* FEC2::78CA::23AB
- The 128-bit address contains two parts.

IPv6 Address Components

An IPv6 address is constructed of two major component as described below:

Component	Description
Prefix	The first 64-bits is known as the prefix. - The 64-bit prefix can be divided into various parts, with each part having a specific meaning. Parts in the prefix can identify the geographic region, the ISP, the network, and the subnet. - The prefix length identifies the number of bits in the relevant portion of the prefix. To indicate the prefix length, add a forward slash (/) followed by the prefix length number. Full quartets with trailing 0s in the prefix address can be omitted (for example, 2001:0DB8:4898:DAFC::/64). - Because addresses are allocated based on physical location, the prefix generally identifies the location of the host. The 64-bit prefix is often referred to as the global routing prefix.
Interface ID	The last 64-bits is the interface ID. This is the unique address assigned to an interface. - Addresses are assigned to interfaces (network connections), not to the host. Technically, the interface ID is not a host address. - In most cases, individual interface IDs are not assigned by ISPs, but are rather generated automatically or managed by site administrators. - Interface IDs must be unique within a subnet, but can be the same if the interface is on different subnets. - On Ethernet networks, the interface ID can be automatically derived from the MAC address. Using the automatic host ID simplifies administration.

Types of IPv6 Addresses

In IPv6, all interfaces are required to have an address, and interfaces can have more than one address. IPv6 identifies the following types of addresses:

Address Type	Description
Link-local	Link-local addresses (also known as local link addresses) are addresses that are valid on only the current subnet. - Link-local addresses have a FE80::/10 prefix. This includes any address beginning with FE8, FE9, FEA, or FEB. - All nodes must have at least one link-local address, although each interface can have multiple addresses. - Routers never forward packets destined for link-local addresses to other subnets.

	▪ Link-local addresses are used for automatic address configuration, neighbor discovery, or for subnets that have no routers.
Unique local	Unique local addresses are private addresses used for communication within a site or between a limited number of sites. In other words, unique local addressing is commonly used for network communications within an organization that do not cross a public network. They are the equivalent of private addressing in IPv4. ▪ Unique local addresses have a FC00::/7 prefix. Currently, however, the 8th bit is always set to 1 to indicate that the address is local (and not global). Thus, addresses beginning with FC or FD are unique local addresses. ▪ Following the prefix, the next 40 bits are used for the Global ID. The Global ID is generated randomly so that there is a high probability of uniqueness on the entire Internet. ▪ Following the Global ID, the remaining 16 bits in the prefix are used for subnet information. ▪ Unique local addresses are likely to be globally unique, but are not globally routable. Unique local addresses might be routed between sites by a local ISP. ▪ Earlier IPv6 specifications defined a site-local address that was not globally unique and had a FEC0::/10 prefix. The site-local address has been replaced with the unique local address. ▪ Because unique local addresses are not registered with IANA, they cannot be used on a public network (such as the Internet) without address translation. The process for designing a network addressing scheme when using unique local addresses is similar to that used for global unicast addresses. The key difference is how the prefix is defined. Because the address range is not registered, a global routing prefix does not have to be requested from an ISP. Instead, each organization defines the prefix to be used for their organization. However, there are several requirements that need to be observed when doing so. As with global unicast addressing, using this addressing scheme allows organizations to define a large number (2^{16}) of IPv6 subnets.
Global unicast	Global unicast addresses are addresses that are assigned to individual interfaces that are globally unique (unique throughout the entire Internet). Global unicast addresses are any addresses that are not link-local, unique local, or multicast addresses. Originally, ISPs assigned global unicast addresses with a 2000::/3 prefix (this includes any address beginning with a 2 or a 3). However, this was later amended so that all IPv6 addresses that haven't been specifically reserved for other purposes are defined as global unicast addresses. The global routing prefix assigned to an organization by an ISP is typically 48 bits long (/48). However, it could be as short as /32 or as long as /56, depending upon the ISP. Using this addressing scheme allows organizations to define a large number (2^{16}) of IPv6 subnets.
Loopback	The local loopback address for the local host is 0:0:0:0:0:0:0:1 (also identified as ::1 or ::1/128). The local loopback address is not assigned to an interface. It can be used to verify that the TCP/IP protocol stack has been properly installed on the host.

There are no broadcast addresses in IPv6. IPv6 multicast addresses are used instead of broadcast addresses.
