Planning for Information Network

Lecture 9

Introduction to IPv6

IPv6 Packet Header

Note:

The IPv6 header does not have a header checksum field. Because link-layer technologies perform checksum and error control and are considered relatively reliable, an IPv6 header checksum is considered redundant. Without the IPv6 header checksum, upper-layer checksums, such as within UDP, are mandatory with IPv6.

Special IPv6 Addresses

IPv6 Address	Description
::/0	• All routes and used when specifying a default static route. • It is equivalent to the IPv4 quad-zero (0.0.0.0).
::/128	• Unspecified address and is initially assigned to a host when it first resolves its local link address.
::1/128	• Loopback address of local host. • Equivalent to 127.0.0.1 in IPv4.
FE80::/10	• Link-local unicast address. • Similar to the Windows autoconfiguration IP address of 169.254.x.x.
FF00::/8	Multicast addresses.
All other addresses	Global unicast address.

IPv6 Address Scope Types

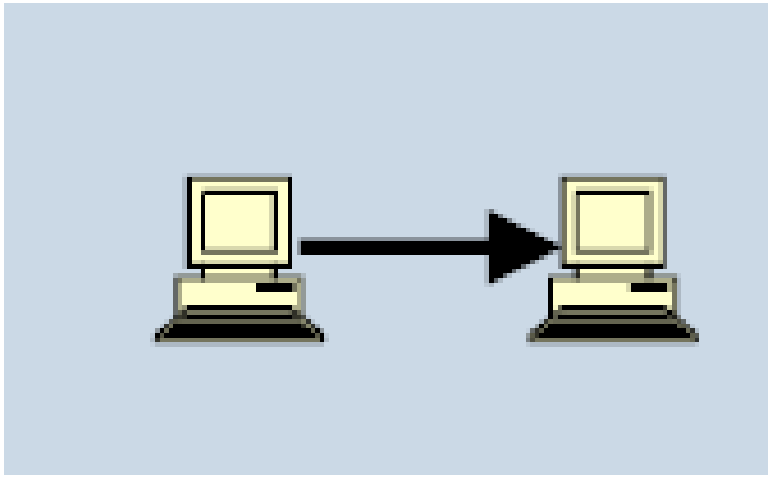
Similar to IPv4, a single source can address datagrams to either one or many destinations at the same time in IPv6.

Following are the types of IPv6 addresses:

■ **Unicast (one-to-one):** Similar to an IPv4 unicast address, an IPv6 unicast address is for a single source to send data to a single destination. A packet sent to a unicast IPv6 address goes to the interface identified by that address. The IPv6 unicast address space encompasses the entire IPv6 address range, with the exception of the FF00::/8 range (addresses starting with binary 1111 1111), which is used for multicast addresses.

IPv6 Address Scope Types

Unicast Topology:



IPv6 Address Scope Types

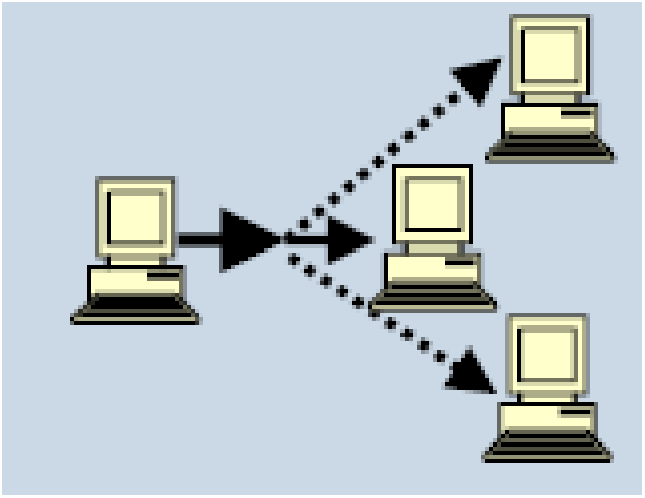
- **Anycast (one-to-nearest):** An IPv6 anycast address is a new type of address that is assigned to a set of interfaces on different devices; an anycast address identifies multiple interfaces. A packet that is sent to an anycast address goes to the closest interface (as determined by the routing protocol being used) identified by the anycast address.

Therefore, all nodes with the same anycast address should provide uniform service. Anycast addresses are syntactically indistinguishable from global unicast addresses because anycast addresses are allocated from the global unicast address space. Nodes to which the anycast address is assigned must be explicitly configured to recognize the anycast address.

Anycast addresses must not be used as the source address of an IPv6 packet. Examples of when anycast addresses could be used are load balancing, content delivery services, and service location. For example, an anycast address could be assigned to a set of replicated FTP servers. A user in China who wants to retrieve a file would be directed to the Chinese server, whereas a user in the Europe would be directed to the European server.

IPv6 Address Scope Types

Anycast topology:



IPv6 Address Scope Types

- **Multicast (one-to-many):** Similar to IPv4 multicast, an IPv6 multicast address identifies a set of interfaces (in a given scope), typically on different devices.

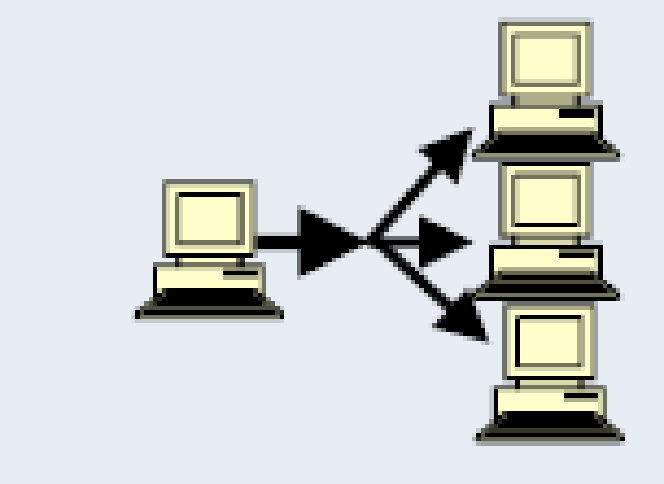
A packet sent to a multicast address is delivered to all interfaces identified by the multicast address (in a given scope). IPv6 multicast addresses have a 4-bit scope identifier (ID) to specify how far the multicast packet may travel.

Scope:

- 1 (0001) = Node
- 2 (0010) = Link
- 5 (0101) = Site
- 8 (1000) = Organization
- E (1110) = Global

IPv6 Address Scope Types

Multicast topology:



IPv6 Address Scope Types

Note:

- IPv6 has no concept of broadcast addresses; multicast addresses are used instead.

- A single interface may be assigned multiple IPv6 addresses of any type (unicast, anycast, and multicast).

Interface Identifiers in IPv6 Addresses

In IPv6, a link is a network medium over which network nodes communicate using the link layer. Interface IDs in IPv6 addresses are used to identify a unique interface on a link. They can also be thought of as the “host portion” of an IPv6 address. Interface IDs are required to be unique on a link and can also be unique over a broader scope.

When the interface identifier is derived directly from the data link layer address of the interface, the scope of that identifier is assumed to be universal (global). Interface identifiers are always 64 bits and are dynamically created based on the data link layer.

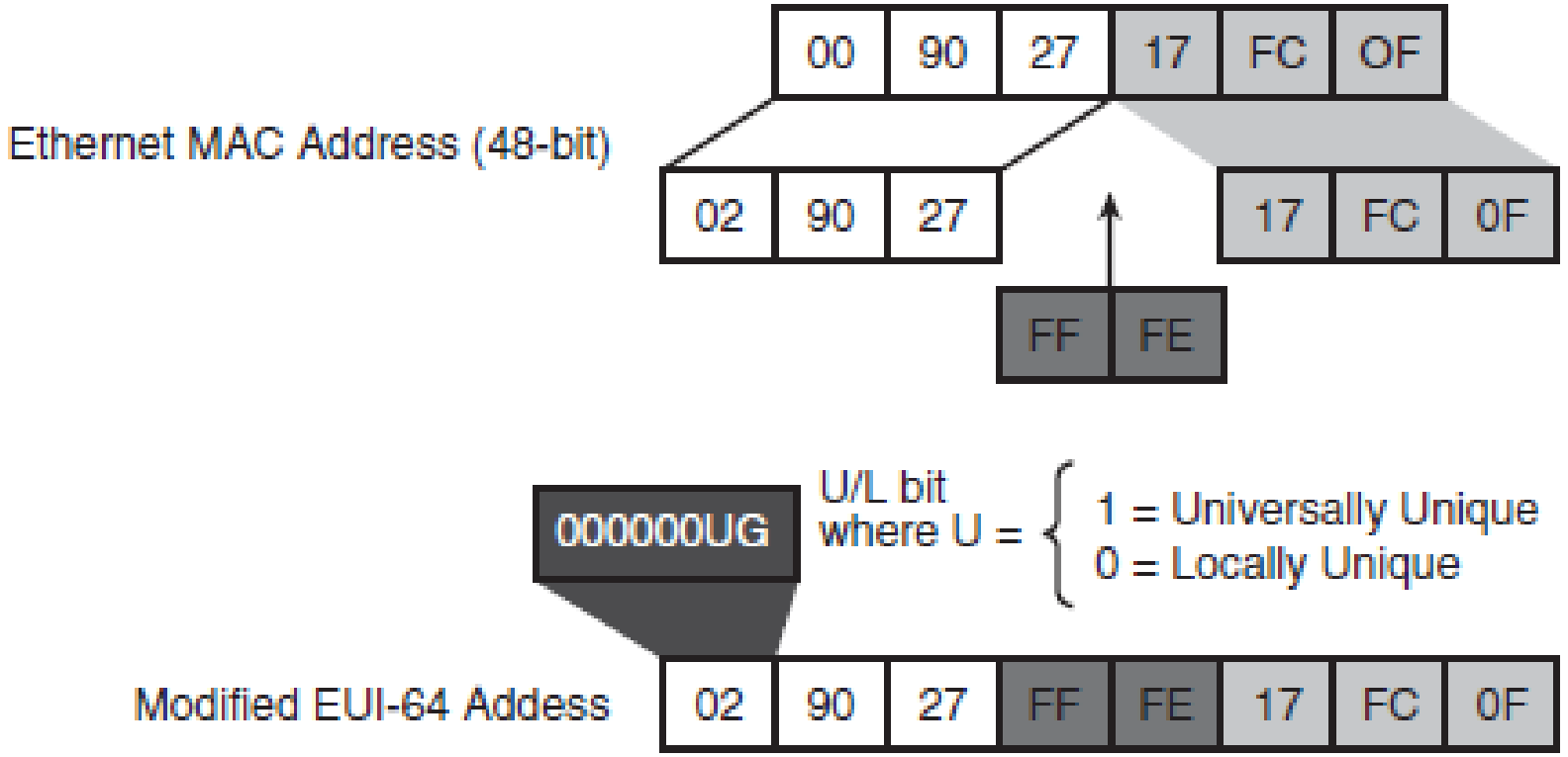
Interface Identifiers in IPv6 Addresses

For Ethernet, the interface ID used is based on the MAC address of the interface and is in an **E**xtended **U**niversal **I**dentifier 64-bit (EUI-64) format.

The EUI-64 format interface ID is derived from the 48-bit link-layer MAC address by inserting the hexadecimal number **FFFE** between the upper 3 bytes (the organizational unique identifier "OUI" field) and the lower 3 bytes (the vendor code or serial number field) of the link-layer address. The seventh bit in the high-order byte is set to 1 (equivalent to the IEEE G/L bit) to indicate the uniqueness of the 48-bit address.

Interface Identifiers in IPv6 Addresses

EUI-64 Format IPv6 Interface Identifier



Interface Identifiers in IPv6 Addresses

The seventh bit in an IPv6 interface identifier is referred to as the **U**niversal/**L**ocal (**U/L**) bit. This bit identifies whether this interface identifier is locally unique on the link or whether it is universally unique.

When the interface identifier is created from an Ethernet MAC address, it is assumed that the MAC address is universally unique and, therefore, that the interface identifier is universally unique. The U/L bit is for future use by upper-layer protocols to uniquely identify a connection, even in the context of a change in the leftmost part of the address. However, this feature is not yet used. The eighth bit in an IPv6 interface identifier, also known as the "**G**" bit, is the **g**roup/individual bit for managing groups.

IPv6 Unicast Addresses

Following are the different unicast addresses that IPv6 supports:

- Global aggregatable address (also called global unicast address)
- Link-local address
- IPv4-compatible IPv6 address

Thank you