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|  | **Experiment No** | 11 |
| **Title of Experiment** | IPv6 |
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**Aim:** To study the concept off IPv6 address.

# IPv6 Addresses –

The size of IPv6 address is 128 bits, i.e., 2128 addresses which is approximately 1038 addresses.

# The Addressing Space –

IPv6 addressing space is subdivided on the basis of the value assumed by leading bits in the address. The field comprising these leading bits is called Format Prefix.

# Syntax of IPv6 Addresses –

• IPv6 addresses are 128 bits long (16 octets) and are written as 8 unsigned integers with four hexadecimal digits. Each one is separated from oneanother by a colon.

## For example - FEDC:BA98:7654:3210:FEDC:BA98:7654:3210

• A further simplification is represented by the symbol (::), which re- places a series of zeros. Using this simplification,

## 1080:0:0:0:8:800:200C:417A becomes 1080::8:800:200C:417A

This kind of simplification is mainly used to write multicast, loopback or unspecified addresses.

• The representation of IPv6 prefixes is similar to the way IPv4 ad- dresses’ prefixes are written in CIDR notation. An IPv6 address prefix is represented by the notation *ipv6-address/prefix-length*

For example, to indicate a subnet with an 80-bit prefix, we use the following notation: **1080:0:0:0:8::/80**

# Types of IPv6 Addresses –

There are three types of IPv6 addresses, namely –

**Unicast –** This type is the address of a single interface. A packet forwarded to a unicast address is delivered only to the interface identified by that address.

**Anycast –** This type is the address of a set of interfaces typically belonging to different nodes. A packet forwarded to an anycast address is delivered to only one interface of the set (the nearest to the source node, according to the routing metric).

**Multicast –** This type is the address of a set of interfaces that typically belong to different nodes. A packet forwarded to a multicast address is delivered to all interfaces belonging to the set.

# The Addressing Model –

Addresses belong to interfaces, not nodes. A node can be identified by any unicast address associated with its interfaces. This is the basic model, but there are two exceptions to this model –

1. A single IPv6 address can be assigned to a group of interfaces belonging to a node if IPv6 implementation treats that group as a single interface when presenting packets to the IP layer. This is basically used in fault tolerant systems.
2. Routers can have unnumbered interfaces, i.e., without any addresses. This is used for the interfaces on point-to-point links where the presence of addresses doesn’t matter.

# Assignment of IPv6 Addresses –

IPv6 is used at a worldwide level. The internet community has decided to give the central authority of IPv6 to Internet Assigned Number Authority (IANA).

Some of the works of IANA are –

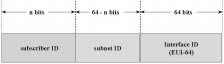
* They will base the IPv6 addressing space management on suggestions coming from the Internet Architecture Board (IAB) and from the Internet Engineering Steering Group (IESG).
* They will try to prevent monopolies and instances of abuse.
* They will develop a plan for the initial IPv6 address allocation.

The IANA has already identified three local authorities to collaborate with for IPv6 address allocation:

* RIPE-NCC (Réseaux IP Européens Network Coordination Centre) for Europe
* INTERNIC (Internet Network Information Centre) for Northern America
* APNIC (Asian and Pacific Network Information Centre) for Asian and Pacific countries

# Unicast Address –

IPv6 unicast addresses are continuous, bit-wise, maskable addresses similar to IPv4 addresses with Classless Inter-Domain Routing (CIDR). The following types of Unicast addresses have been specified: Aggregatable Global Unicast, Geographic-based, IPv4, NSAP, IPX, Link Local, Site Local, non-specified, and loopback



* **Aggregatable Global Unicast -** Aggregatable Global Unicast addresses are specified in IP Version 6 Addressing Architecture 16. These addresses, which are characterized by FP = 001.
* **Geographic-Based Addresses -** Geographic-based addresses have been studied and proposed in the SIP Project.Geographic-based addresses have not yet been definitively abandoned, shown by the fact that they have been allocated 1/8 of the IPv6 addressing space FP=100
* **Link Local Addresses -** Link Local addresses (FP = 1111 1110 10) are designed to be used on each link for address autoconfiguration and for neighbour discovery functions.
* **Site Local Addresses -** Site Local (FP = 1111 1110 11) addresses are designed to replace IPv4 addresses defined by RFCs 1597 and 1918 for use in Intranets. Site Local addresses are therefore ideal for organizations not (yet) connected to the global Internet.

## • Unspecified Address - The address

0000:0000:0000:0000:0000:0000:0000:0000 is also called the unspecified address, and it can be written in the compressed form ::. It must never be assigned to any interface because it indicates the ab- sence of an IPv6 address.

## • The Loopback Address - The address

000:0000:0000:0000:0000:0000:0000:0001 is also called the loopback address (its compressed form is ::1), and it is used by a node to send an IPv6 packet to itself. It must never be assigned to any inter- face.

* **NSAP Addresses –** NSAP addresses are binary stings up to 20 octets long defined in the OSI project by the standard ISO 8348.
* **IPX Addresses -** IPX is a connectionless protocol that assigns addresses to interfaces and is therefore very similar to IP.

# Anycast Addresses –

Anycast addresses don’t have separate addressing spaces (no particular FP value identifies anycast addresses); they simply are unicast addresses assigned to more than one interface.

There are two restrictions on the use of IPv6 anycast addresses –

1. Anycast addresses must not be used as source addresses on IPv6 packets.
2. Anycast addresses must not be assigned to IPv6 hosts—that is, they can be assigned to IPv6 routers only.

# Multicast Addresses –

A multicast address is a specific type of IP address labelling a network location that is used to multicast data packets within a network. It stands in contrast to other IP addresses that only allow for unicast models. This feature is used widely by new multimedia applications that frequently need to transmit from one node to many nodes. **Addresses for a Node –**

List of all addresses that an IPv6 node can have –

## • Addresses of a Host –

A host is required to recognize the following addresses as identifying itself:

1. Its Link Local address for each interface 2. Unicast addresses assigned to interfaces

1. The loopback address.
2. All-Nodes multicast address
3. Neighbour Discovery multicast addresses associated with all unicast and anycast addresses assigned to interfaces
4. Multicast Addresses of groups to which the node belongs

## • Addresses of a Router –

A router is required to recognize the following addresses as identifying itself:

1. Its Link Local address for each interface 2. Unicast addresses assigned to interfaces

1. The loopback address.
2. The Subnet Router anycast address for all links on which it has interfaces
3. Other anycast addresses assigned to interfaces
4. All-nodes multicast address
5. All-routers multicast address
6. Neighbour Discovery multicast addresses associated with all unicast and anycast addresses assigned to interfaces
7. Multicast addresses of groups to which the node belongs

# The EUI-64 Interface Identifier –

* The IEEE has introduced a new type of MAC address, 64-bits long, called the EUI-64. Until now, MAC addresses have been on 48 bits: 24 bits assigned by the IEEE and 24 bits manufacturer selected.
* Mapping the old 48-bit MAC addresses to a new 64-bit representation is also possible. To obtain an IPv6 interface identifier from an EUI-64 address, we must complement the Universal/Local bit—that is, the nextto-last bit of the first octet.