Anatomy of

IPv6 Unicast Addresses

128

An IPv6 address is a 128-bit identifier of an interface or set of interfaces that attach a host to a **link**. The address is represented as eight groups of four hexadecimal digits, each group representing 16 bits. The groups are separated by colons ':'.

A unicast address identifies a single interface. The unicast address is divided into two parts: a subnet prefix of arbitrary bit-length is associated with a single link, and an interface identifier to distinguish each interface on the link.

The subnet prefix is written as: ipv6-address/prefix-length.

An example of an IPv6 address is: 2001:0db8:7654:0003:0000:0000:0000:abcd/64. It can be compressed as 2001:db8:7654:3::abcd/64

3

There are three types of unicast addresses: **Global Unicast** addresses are globally unique in the Internet. **Unique local** addresses are also globally unique but they are intended for use within a **site** and not routed globally. **Link-Local** unicast addresses are valid only within a single link (subnet).

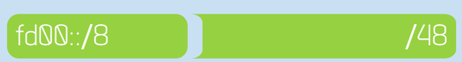
Global Unicast

The global routing prefix is an ***n*-bit** value assigned by a **RIR** or **ISP** to a site (representing an end user). RIRs are allocated /12 IPv6 address blocks from IANA. Currently, all global unicast addresses start with 2000::/3.

LIRs (or ISPs) should be allocated /32 address block. Large LIRs may get larger blocks (shorter prefix).

End users receive their IPv6 address blocks from their ISPs or directly from RIRs depending on their needs. The minimum assignment for **PI** end user is /48. Users with multiple sites may receiver larger blocks. **PA** assignments varies in size. For instance, residential users typically receive /56 prefixes. The minimum assignment of /64 should be used only when it is known that one and only one subnet is needed.

Unique Local



Unique local addresses start with fd00/8. The subsequent **40 bits** can be generated pseudo-randomly to reduce the likelihood that any two networks use the same prefix.

Site administrators will have 16-bit Subnet ID that they can use to structure their network.

Link Local

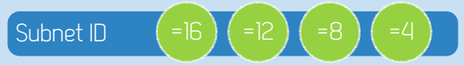
Link local addresses have a fixed prefix of fe80::/64. These addresses cannot be routed outside the link.

n

m

Subnet ID

The ***m*-bit** Subnet ID length (*m*=64-*n*) determines the maximum number of subnets configurable within a site. Site administrators are responsible for structuring and assigning the subnet IDs. It is recommended that administrators divide the subnet ID into fields at 4-bit boundary lines (nibbles) to simplify the administration of the address space.



Administrators can divide the Subnet ID field into groups of bits, where each group maps to either a supported function or a location within the network. The groups of bits can also be used to map the IPv6 address subnets to **VLAN** IDs.

64

Interface ID

Interface ID should be **64-bit** long. This means that all IPv6 subnets are of the same size.

Manual SLAAC DHCP

IPv6 Interface IDs are assigned by site administrators using three primary methods: static (manual), dynamic via **DHCP**, or automatic via **SLAAC**.

SLAAC is supported on IPv6 routers. It allows a host on a particular link to self-assign a unique address and allows the host to connect to and communicate with other nodes. SLAAC may use a **Modified EUI-64** to generate an interface ID based on the 48-bit **MAC** address of the IPv6 interface. To address privacy concerns or to deal with interfaces that do not have MAC addresses (e.g. serial interfaces), a randomly generated address may be used.

Looking for IPv6 tools?

DynamikNets has published "IP Address Calculator", an Android™ app that can be used as a tool to design IPv4 and IPv6 addressing plans. For more information, visit (http://dynamiknets.com/2016/06/ip-address-calculator).

Android is a trademark of Google Inc.

Sites and links

IPv6 uses the term ***Site*** to refer to a cluster of links. The term ***Link*** refers to a communication medium such as a point-to-point connection or an Ethernet segment.

A single IPv6 Interface can respond to multiple IPv6 addresses, including:

- ✓ Unicast/Anycast addresses
- ✓ A link-local address
- ✓ Solicited node multicast addresses
- ✓ Multicast addresses

Most of the IPv6 address space is dedicated to unicast addressing.

2000::/3

Only 1/8th of the IPv6 address space is currently available for Global Unicast Address assignments.

Acronyms

DHCP = Dynamic Host Configuration Protocol.
EUI-64 = 64-bit Extended Unique Identifier
IANA = Internet Assigned Numbers Authority
ISP = Internet Service Provider
LIR = Local Internet Registry
MAC = Media Access Control
PA = Provider Allocated
PI = Provider Independent
RIR = Regional Internet Registry
SLAAC = Stateless Address Auto-configuration
VLAN = Virtual Local Area Network

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