SNS COLLEGE OF TECHNOLOGY

Coimbatore-35
An Autonomous Institution

Department of Information Technology

Course Name – 19IT302 Internet of Things

III Year / V Semester

Unit 4 – IPv6 TECHNOLOGIES FOR THE IOT

Topic 1- Motivations - Address Capabilities - IPv6 Protocol Overview

IPv6 - Motivations

Challenges

The current IPv4 has been in use for over 30 years, but it exhibits some challenges in supporting emerging demands for

- address space cardinality,
- high-density mobility,
- multimedia, and
- strong security.

- IPv6 offers the potential of achieving scalability, reachability, end-to-end interworking, quality of service (QoS), and commercial grade robustness that is needed for contemporary and emerging web services, data services, mobile video, and Internet of things (IoT) applications.

- IPv6 was initially developed in the early 1990s because of the anticipated need for more end-system addresses based on anticipated Internet growth, encompassing mobile phone deployment, smart home appliances, and billions of new users in developing countries.

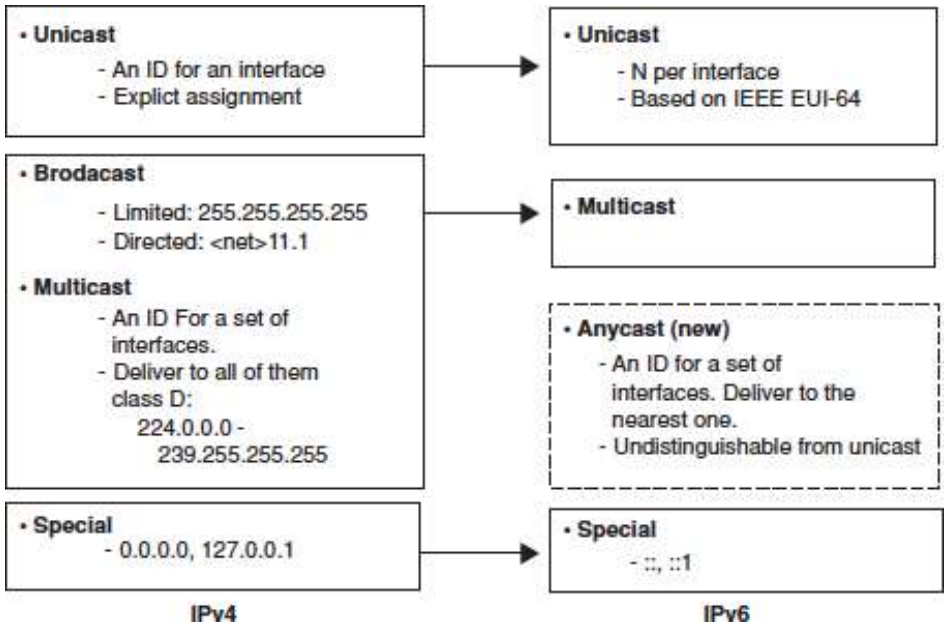
IPv6 – Address Capabilities

IPv4 Addressing and Issues

- IPv4 – 32 bit address, allows upto 2^{32} address, i.e.- 4,294,967,296 unique values.
- The problem is that during the 1980s, many public, registered addresses were allocated to firms and organizations without any consistent control.
- As a result, organizations have more addresses that they actually might need, giving rise to the present dearth of available “registerable” layer 3 addresses.
- NAT is used to alleviate this issue by map the internal addresses to an external public address when the private-to-public network boundary is crossed
- The need for obligatory use of NAT disappears with IPv6.

IPv6 – Address Capabilities

IP Version	Size of Address Space
IPv6	128 bits, which allows for 2^{128} or 340,282,366,920,938,463,463,374,607,431,768,211,456 (3.4×10^{38}) possible addresses
IPv4	32 bits, which allows for 2^{32} or 4,294,967,296 possible addresses



Changes in IPv6 Addressing

- Unicast - Same function as in IPv4
- Broadcast – Eliminated and replaced by multicast by expanding functions
- Anycast – Totally a new approach, "send to any one member of this specific group
- There are a number of special IPv6 addresses

IPv6 – Address Capabilities

IPv6 Address Space

- The IPv6 address is represented as eight groups of 16 bits each, separated by the ":" character.
- Each 16-bit group is represented by 4 hexadecimal digits, that is, each digit has a value between 0 and f (0,1, 2, . . . a, b, c, d, e, f with a = 10, b = 11, and so on, to f = 15).

Example
3223:0ba0:01e0:d001:0000:0000:d0f0:0010

An abbreviated format exists to designate IPv6 addresses when all endings are 0.

For example

3223:0ba0:0000:0000:0000:0000:0000:0000 is represented as 3223:0ba0::

Simlarly
3223:0ba0:0000:0000:0000:0000:0000:1234 is represented as 3223:ba0:0:0:0:0::1234

IPv6 – Address Capabilities

Special IPv6 addresses, as follows

- Auto-return or loopback virtual address. This address is specified in IPv4 as the 127.0.0.1 address. In IPv6, this address is represented as ::1.

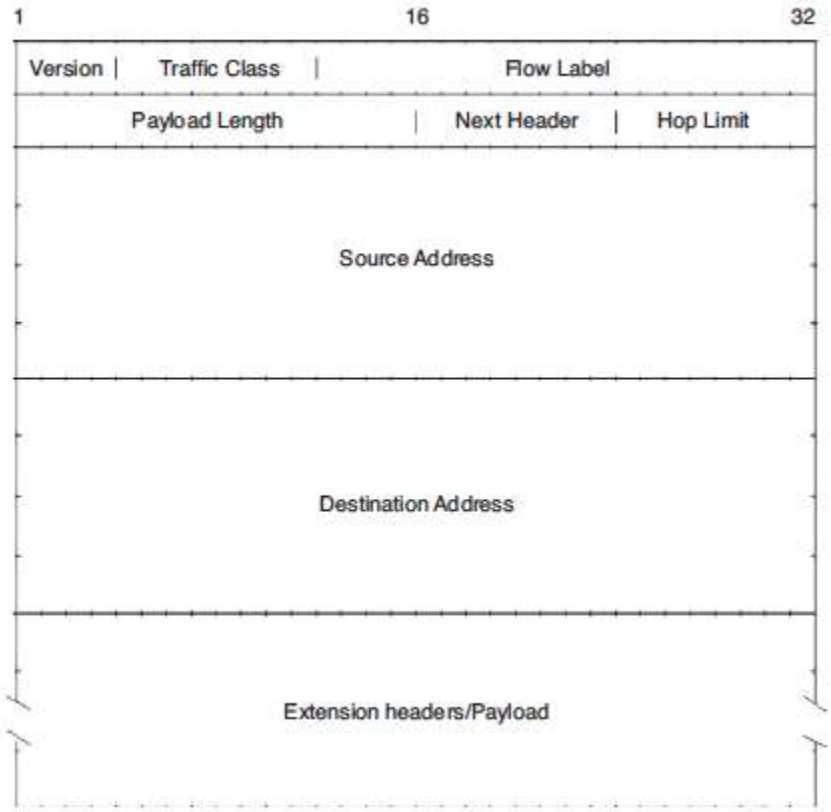
- Not specified address (::). This address is not allocated to any node since it is used to indicate absence of address.

- IPv6 over IPv4 dynamic/automatic tunnel addresses. These addresses are designated as IPv4-compatible IPv6 addresses and allow the sending of IPv6 traffic over IPv4 networks in a transparent manner. They are represented as, for example, ::156.55.23.5.

- IPv4 over IPv6 addresses automatic representation. These addresses allow for IPv4-only nodes to still work in IPv6 networks. They are designated as “mapped from IPv4 to IPv6 addresses” and are represented as ::FFFF:, for example ::FFFF.156.55.43.3.

IPv6 – Overview

IPv6 is a connectionless, unreliable, best effort datagram protocol used primarily for addressing and routing packets between hosts.

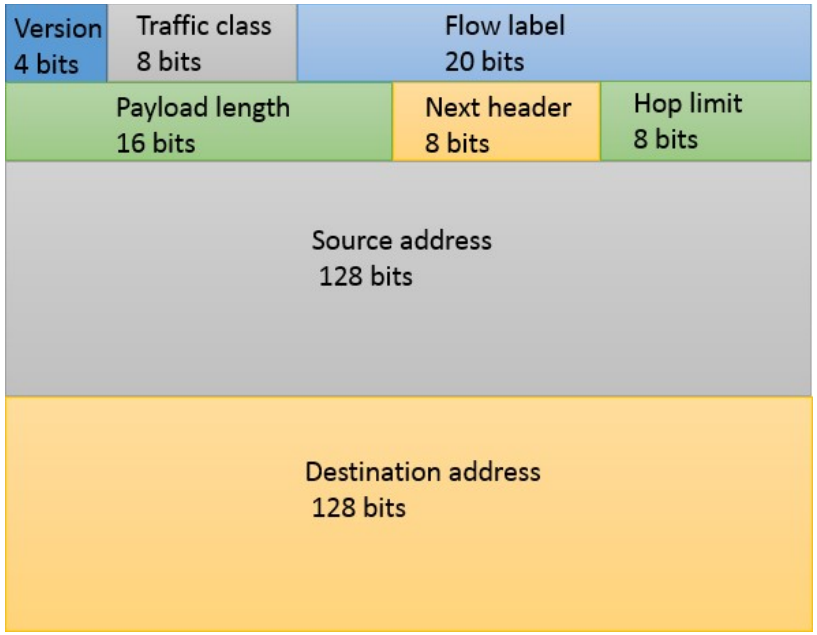


Packet Format

- Every packet has IPv6 header and an IPv6 payload
- The IPv6 header consists of two parts, the IPv6 base header and optional extension headers
- The header size is fixed 40 bytes.
- Version – 4 bits - Indicates version of IP which is 6
- Traffic class - 8 bits - Differentiated Services and Priority field used for Explicit congestion notification.

IPv6 – Overview

Base Header



Flow Label - 20 bits - Defines how traffic is handled and identified.

Payload length – 16 bits - The size of the payload in octets, including any extension headers, as well as the upper-layer Protocols.

Next Header – 8 bits - Identifies the header immediately following the IPv6 header (Extension header). Whereas In some cases it indicates the protocols contained within upper-layer packet, such as TCP, UDP.

Hop limit – 8 bits - Identifies the number intermediate nodes on which the packet is allowed to travel before being discarded by a router. The hop limit is set by the sending host and is used to prevent packets from endlessly circulating on an IPv6 internetwork.

IPv6 – Overview

The IPv6 specification defines a number of extension headers

- Routing header—Similar to the source routing options in IPv4. The header is used to mandate a specific routing.
- AH—A security header that provides authentication and integrity.
- Encapsulating security payload (ESP) header—A security header that provides authentication and encryption.
- Fragmentation header—The Fragmentation Header is similar to the fragmentation options in IPv4.

IPv6 – Overview

Autoconfiguration

- Autoconfiguration is a new characteristic of the IPv6 protocol that facilitates network management and system set-up tasks by use. It also called as plug and play.
- Without using DHCP server for IPv6 address are configured.
- Every IPv6 system (other than routers) is able to build its own unicast global address using this autoconfiguration.
- SLAAC term also used for autoconfiguration. It expands to stateless address autoconfiguration .
- The host generates its own address using a combination of the information that it possesses (in its interface or network card) and the information that is supplied by the router.
- To ensure that allocated addresses (granted either by manual mechanisms or by autoconfiguration) are unique in a specific link, the link duplicated address detection algorithm is used. It removes duplicate address.

IPv6 – Overview

IPv6 Address Formation

- It is 128 bit address. The lowest 64 bits of the address identify a specific interface, and these bits are designated as “interface identifier “.
- The highest 64 bits of the address identify the “path” or the “prefix” of the network or router in one of the links to which such interface is connected.
- The IPv6 address is formed by combining the prefix with the interface identifier
- It is possible for a host or device to have IPv6 and IPv4 addresses simultaneously.
- It is also possible to transmit IPv6 traffic over IPv4 networks via tunneling methods. This approach consists of “wrapping” the IPv6 traffic as IPv4 payload data.

THANK YOU