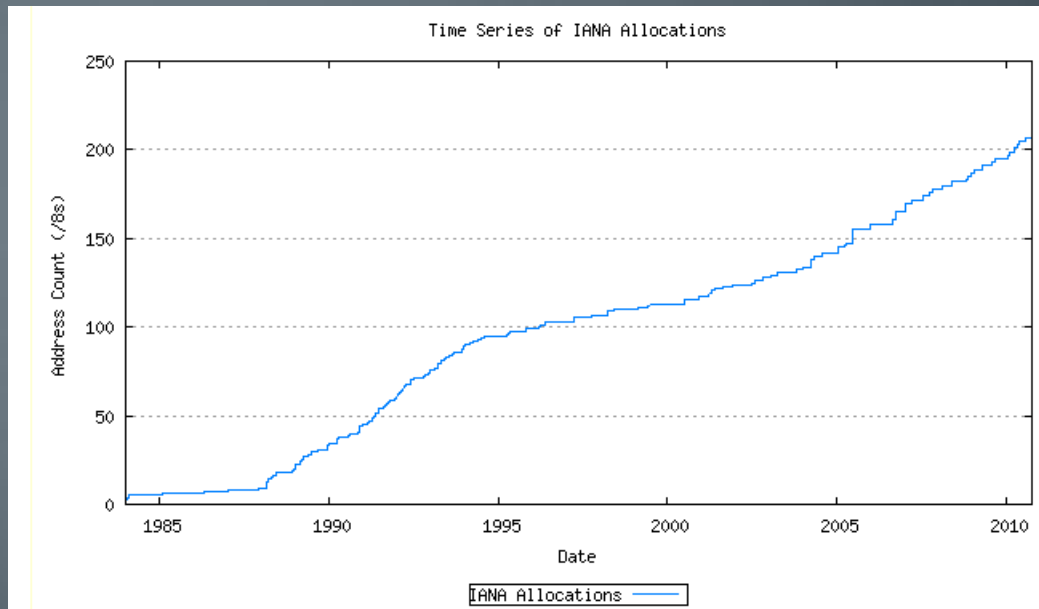


IPv6 and Dual Stack in Mobile wireless communications

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IPv4 Address Space Exhaust

- Several market forces accelerated IPv4 address exhaustion:
 - Rapidly growing number of Internet users
 - Always-on devices — ADSL modems, cable modems
 - Mobile devices — laptop computers, PDAs, mobile phones



- IPv6 will provide enough addresses to allow for every region, country and company to have an abundance of IP addresses to meet their need.

Benefits of IPV6

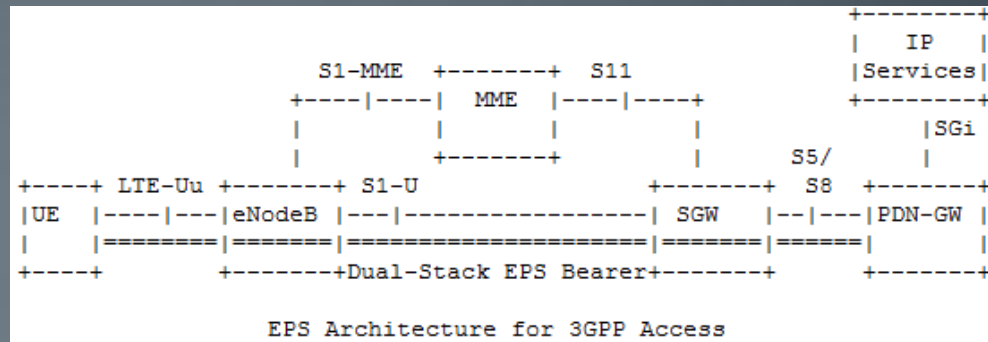
- **Increased address space:** IPv6 3.4×10^{38} addresses vs IPv4 4.29×10^9 addresses.
- **Easier management of networks:** IPv6 networks provide autoconfiguration capabilities but IPv4 networks must be configured manually or with DHCP.
- **End-to-end connective integrity:** Direct addressing is possible due to vast address space, IPv6 not need NAT.
- **Improved security features:** IPSEC is built into the IPv6 protocol, usable with a suitable key infrastructure but IPv4 security is dependent on applications.

IPv4-to-IPv6 Transition Mechanisms

- **Dual-stack**: Dual-stack refers to an IP capable device supporting simultaneously both IPv4 and IPv6. This enables applications to communicate across either an IPv4 or IPv6 network. Many of the routers available today support this dual-stack capability.
- **Tunneling**: Tunneling refers to a technique that encapsulates one version of IP in another so the packets can be sent across a network that does not support the encapsulated IP version.
- **Protocol Translation**: Translation refers to a method of translating one version of IP to another. This method does not depend on dual-stack for transition to IPv6, but rather enables devices on different versions of IP to communicate with each other through an intermediate device which performs protocol translation.

3GPP Terminology and Concepts (EPS)

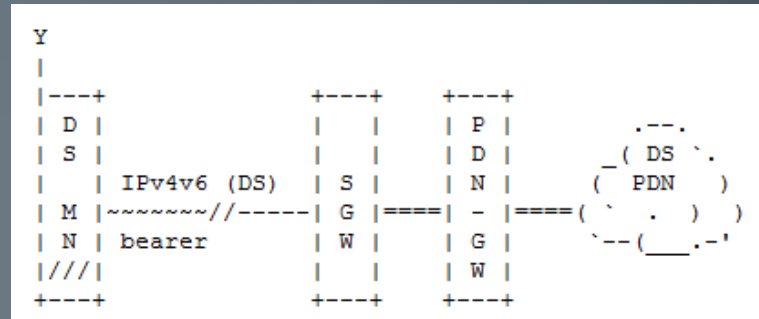
- A PDN connection is the EPC equivalent of the GPRS PDP context.



- In EPS terminology, the virtual connection between two endpoints (UE and PDN-GW) is called an “EPS Bearer”. As a concept, the EPS Bearer corresponds to the “PDP Context” used in GPRS.
- A term that emphasizes the fact that the virtual connection provides a “bearer service”, i.e. a transport service with specific QoS attributes.

3GPP Release-8 and -9 Networks

- Since 3GPP Release-8, the concept of a dual-stack type of PDN connection and EPS bearer have been introduced. This enables parallel use of both IPv4 and IPv6 on a single bearer (IPv4v6), and makes dual stack simpler than in earlier 3GPP releases.



- PDP contexts/PDN bearer types that are specified by 3GPP:

1. For 2G/3G access to GPRS core pre-Release-9 there are two IP PDP Types, IPv4 and IPv6. Two PDP contexts are needed to get dual stack connectivity.
2. For 2G/3G access to GPRS core from Release-9 there are three IP PDP Types, IPv4, IPv6 and IPv4v6. Minimum one PDP context is needed to get dual stack connectivity.
3. For 2G/3G access to EPC core from Release-8 there are three IP PDP Types, IPv4, IPv6 and IPv4v6 which gets mapped to PDN Connection type. Minimum one PDP Context is needed to get dual stack connectivity.
4. For LTE (E-UTRAN) access to EPC core from Release-8 there are three IP PDN Types, IPv4, IPv6 and IPv4v6. Minimum one PDN Connection is needed to get dual stack connectivity.

Deployment issues: Addresses

- Standard **NAT44** functionality enables the communication between hosts that are assigned the same IPv4 address but belong to different zones, yet are part of the same operator domain.
- **NAT64** is a mechanism to allow IPv6 hosts to communicate with IPv4 servers. The IPv6 client embeds the IPv4 address it wishes to communicate with using these bits, and sends its packets to the resulting address. The NAT64 server then creates a NAT-mapping between the IPv6 and the IPv4 address, allowing them to communicate.
- **GI-DS LITE** was designed to let an Internet service provider omit the deployment of any IPv4 address to the customer. Instead, only global IPv6 addresses are provided.

Deployment issues: IPV6 for transport

- The various reference points of the 3GPP architecture such as S1-U, S5 and S8 are based on either GTP or PMIPv6. The underlying transport for these reference points can be IPv4 or IPv6.
- GTP has been able to operate over IPv6 transport (optionally) since R99 and PMIPv6 has supported IPv6 transport starting from its introduction in Release-8.
- The transport links between the eNodeB and the SGW, and the link between the SGW and PDN-GW can be migrated to IPv6 without any direct implications to the architecture.
- The user plane traffic between the mobile host and the gateway can use either IPv4 or IPv6. These packets are treated as payload by GTP/PMIPv6 and transported accordingly with no real attention paid to the information contained in the IPv4 or IPv6 headers.

Deployment issues: Running Dual-Stack

- Running dual-stack networks requires the management of multiple IP address spaces. Tracking of hosts needs to be expanded since it can be identified by either an IPv4 address or IPv6 prefix.
- Network elements will also need to be dual-stack capable in order to support the dual-stack deployment model.
- Deployment and migration cases for providing dual-stack like capability may mean doubled resource usage in operator's network.

Conclusions

- The 3GPP network architecture and specifications enable the establishment of IPv4 and IPv6 connections through the use of appropriate PDP context types.
- With Release-8, 3GPP has specified a more optimal PDP context type which enables the transport of IPv4 and IPv6 packets within a single PDP context between the mobile station and the gateway.
- The current generation of deployed networks can support dual-stack connectivity if the packet core network elements such as the SGSN and GGSN have the capability.
- As devices and applications are upgraded to support IPv6 they can start leveraging the IPv6 connectivity provided by the networks while maintaining the fallback to IPv4 capability.