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Transition to IPv6
in 2G and 3G mobile networks

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Contents

Introduction

- IPv4 has difficulties with the explosive increase in the number of Internet users.
- Private IP address spaces and NATs do not work in the long run.
  - New generation of applications, such as IP telephony and push applications, assume unique addressing and client reachability.
- IPv6 is a good solution for the problems identified with IPv4.
  - IPv6 is well standardised by IETF and ready to be utilised.
  - 3GPP has specified IPv6 as a mandatory protocol in Rel4/Rel5 IM CN (IP Multimedia Core Network).
- IPv4 to IPv6 transition issues need special care and attention. An efficient interworking between IPv4 and IPv6 is needed during the transition period.
- The final target architecture is to make all services function on the IPv6 platform. This will simplify the network architecture.

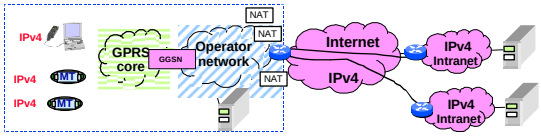
Transition methods

- The main transition mechanisms are
  - dual IPv4 / IPv6 stacks in network elements and mobile terminals
  - tunneling (automatic and configured)
  - IPv4 - IPv6 protocol translators in the network
- The principal transition mechanisms are dual stacks and tunneling.
- Translators (such as NAT-PT) are used if the communicating elements do not share the same version of IP.
- The most important elements needing dual stacks in the mobile network are GGSN elements, mobile terminals, edge routers and DNS servers.
- IPv6 support is also needed in application servers and proxies, such as WAP gateways, web proxies and E-mail servers.
- The majority of the transition mechanisms is provided by the network in order to keep the mobile terminal functionality as light as possible.

Transition phases 1/2

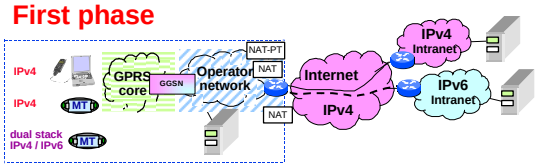
• The starting position: GPRS / WCDMA network supporting only IPv4.
• All terminals / laptop computers are native IPv4 equipment.
• NATs are used due to limited number of public IPv4 addresses.

IPv4 world today - the starting point



• In the first phase, there are separate IPv6 islands in the network.
• Most IPv6 services are provided in the operator network (Intranet).
• Conventional IPv4 services are provided to the mobile users having IPv4 or dual stack terminals.

First phase



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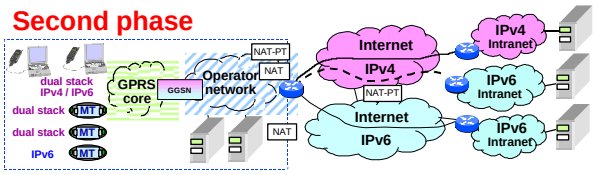
Transition phases 2/2

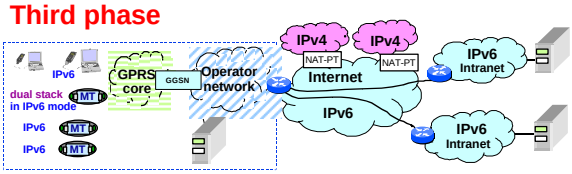
• In the second phase, IPv6 is widely deployed and numerous services are implemented on the IPv6 platform.
• IPv6 Internet does not yet have a 100 per cent connectivity and tunneling via IPv4 Internet may still be needed.

Second phase



• In the third phase, IPv6 has reached dominating position and all services work on IPv6 platform.
• No protocol / address translators are vitally needed in cellular networks.
• Some separate IPv4 networks still exist.

Third phase



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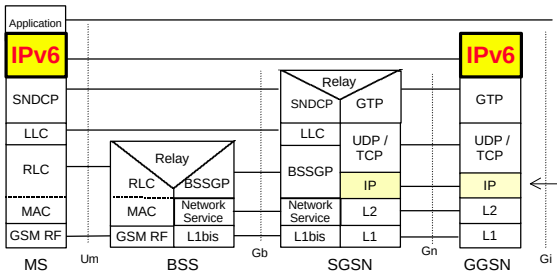
Application layer (user layer) IP

a) GPRS

application layer (user layer) IP

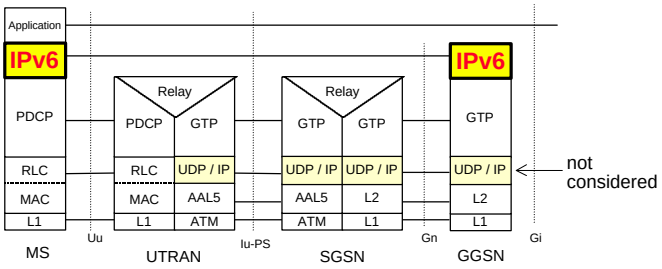
Application layer (user layer) IP is considered in the transition scenarios.



b) WCDMA

application layer (user layer) IP

Figures from 3G TS 23.060 specification



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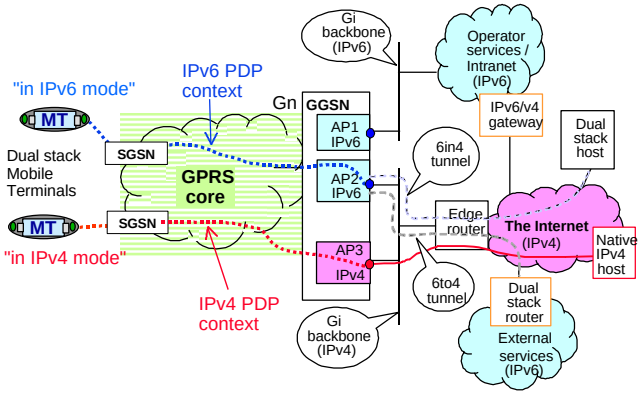
Connections to IPv4 and IPv6 services via different GGSN Access Points

- The connection established between the mobile terminal and a GGSN Access Point (AP) is called a PDP (Packet Data Protocol) context.
- The mobile receives its IP address in the activation of the PDP context.
- Different domains (IPv4, IPv6, ..) are found beyond different access points.



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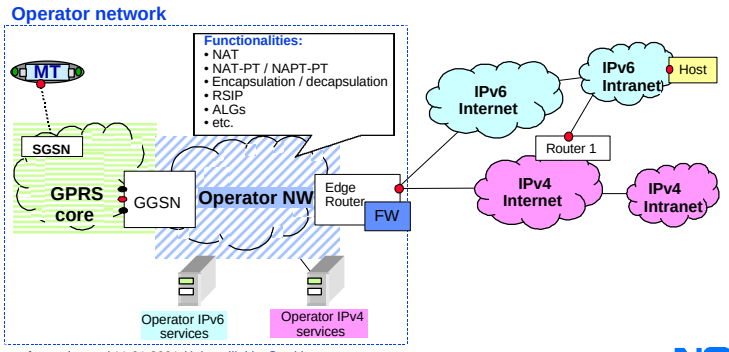
The reference network in the transition scenarios

- Two entities: the operator network and the IP networks beyond that.
- Operator own IPv6 and IPv4 services are in the Intranet, all public Internet connections can be found behind the edge router.
- Connections to IPv4 and IPv6 hosts (e.g. in corporate access networks) are established over IPv4 Internet or IPv6 Internet.
- Different functionalities (like NAT-PT) possibly needed are described.



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IPv4 / IPv6 interoperability

- IPv4 / IPv6 interoperability: the IP versions of the mobile terminal and the peer host are the two most fundamental things.
- Also the IP network type between those two nodes can vary (native IPv4, native IPv6 or a mixture of both).
- If the two communicating IP nodes do not share the same version of IP, protocol translators (like NAT-PT) are needed. Dual stack is a good solution to ensure that the communicating nodes do share the same version of IP.
- Three different types of network services:
  - IPv4 services received via IPv4 Internet.
  - IPv6 services over IPv6 network.
  - IPv6 services over IPv4 network – communicating IPv6 nodes / networks are connected via IPv4 Internet by tunneling. Using protocol translation is also possible.

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Some transition scenarios

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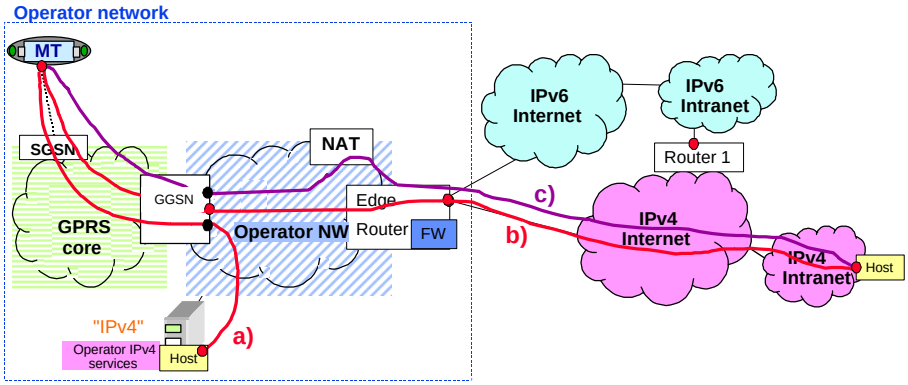
Native IPv4 terminal

- Three cases are shown: a) connection to an IPv4 host in Intranet;
  b) connection to an IPv4 host via public Internet;
  c) connection to an IPv4 host via public Internet using private IP addresses and NAT in the operator network.



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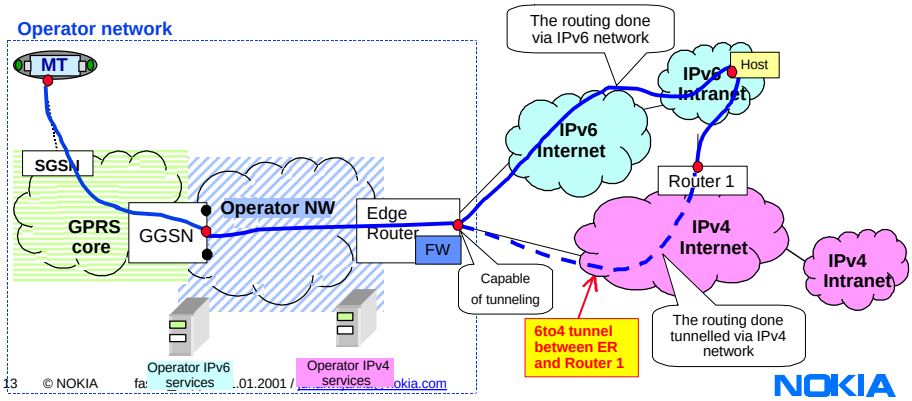
Dual stack terminal

- The dual stack terminal is operating in IPv6 mode.
- The packets are routed via IPv6 Internet or tunnelled via IPv4 Internet to the peer host having a "6to4" type of address.
  - The edge router makes the "6to4" tunneling (encapsulation / decapsulation).



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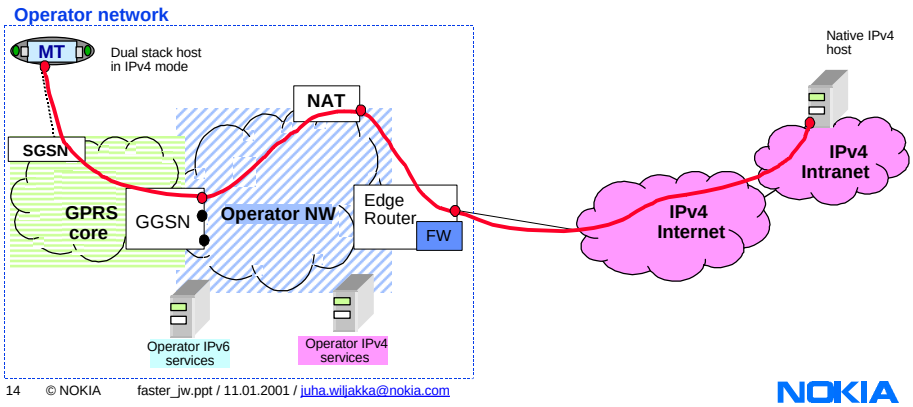
Dual stack terminal

- The dual stack mobile terminal is operating in IPv4 mode. A private IPv4 address is allocated to the terminal.
- NAT functionality is needed when the mobile terminal is communicating with a native IPv4 host via IPv4 Internet.



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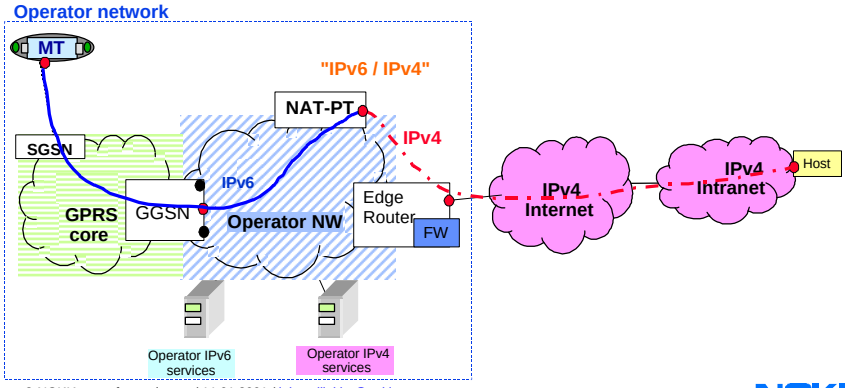
Native IPv6 terminal

- The native IPv6 terminal is communicating with an IPv4 host via IPv4 Internet.
  - NAT-PT (or other translation) function is necessarily needed in the operator network.
  - If the terminal was a dual stack terminal, no translator would be needed.



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Conclusions

- Gradual, controlled transition to IPv6 in 2G / 3G mobile networks is feasible.
- Transition mechanisms are vital, because the change from IPv4 to IPv6 is not going to happen overnight.
- The principal transition mechanisms used are dual IPv4 / IPv6 stacks and tunneling. Translators (such as NAT-PT) are used if the communicating elements do not share the same version of IP.
- The final target architecture is to make all services function on the IPv6 platform. This enables the simplification of the network architecture also from the maintenance point of view.
- When the transition to IPv6 has been successfully finalised, there are enough IP addresses for every piece of equipment.
- Also see: www.nokia.com/ipv6

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