IPv6 on Nokia Siemens Networks Strategy

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Agenda

1. **Nokia Siemens Networks - Company Overview**
2. **The Need for IPv6**
3. **Transition to IPv6**
4. **Wrap Up**

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Global company with a rich heritage

- Joint venture of Nokia and Siemens, recently acquired Motorola's wireless networks infrastructure business
- Started operations on April 1, 2007
- €12.7 bn net sales in 2010
- 120+ years of telecom experience
- ~74,000 employees
- ~46,000 service professionals (including externals)
- > 80 out of the top 100 operators worldwide
- 150+ countries
- 3 billion mobile subscribers and ¼ of world's voice households served

Nokia Siemens Networks – an industry leader

Focused on helping CSP's transform their network, operations, the customer experience and ultimately, the CSP's business

- Strong number 2 in the global wireless segment
- Number 3 in global telecoms market
- Number 1 in mobile broadband
- Best response to the 3G smart device challenge
- Commercial and technological leadership in LTE
- Fastest growing professional services and managed services in the industry
- Number 1 in OSS/BSS deliveries
- Number 1 in customer experience management
- Financial strength and stability
- Broad scope of action:
  - Business Solutions
  - Global Services
  - Network Systems

Ubiquitous IP

One common denominator to NSN's portfolio

Most efficient usage of available\ spectrum

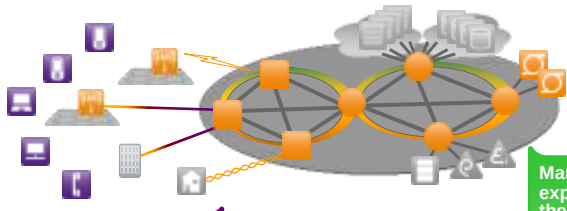
GPRS HSPA LTE WiFi CDMA WCDMA

Flexible transport and optimal delivery of content

DWDM MPLS-TP IP/MPLS MPLS VPNs NGN Release4 IMS Packet Core Evolved Packet Core

Support of cloud services and use of virtualization

Multi Screen TV
Mobile Internet Browsing
Messaging
Location Based Services
VAS as a Service
Rich Communication
Cloud Computing
Machine to Machine (M2M)



Multi-media broadband access

DSL GPON NGOA MWR FTTH NG-SDH

Management of user experience and control of the network

Subscriber Data Management
Service Quality Management
Reporting and Analytics
Identity Management
Customer Care Automation
Device Management

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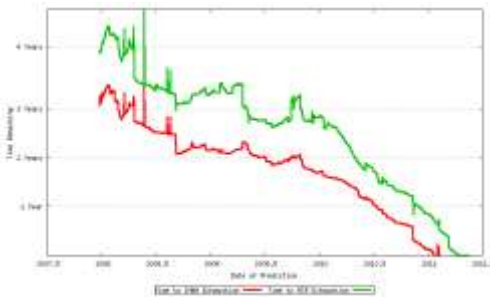
Main motivation for IPv6: IPv4 address depletion

- IPv4 Address Report by Geoff Huston as of 17-May-2011



IANA Unallocated Address Pool Exhaustion: 01-Feb-2011

Projected RIR Unalloc. Address Pool Exhaustion: 15-Apr-2011

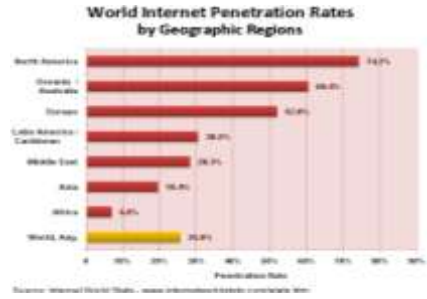
Current RIR Address Status

RIR	Assigned Addresses (/8s)	Remaining Addresses (/8s)
AFRINIC	8.2527	4.7434
APNIC	53.7902	1.2098
ARIN	77.9109	6.0148
LACNIC	15.6416	4.3584
RIPE NCC	45.0201	3.9799

- With the current available address space it is not possible to meet the huge increase of needs of users, service providers and enterprises or the geographical needs of the Internet expansion
- Internet Assigned Numbers Authority (IANA) already run out and subsequently the five Regional Internet Registries (RIRs) are expected to run out of IPv4 addresses for direct assignments by 2H2011

Source: http://www.potaroo.net/tools/ipv4/index.html

Facts on IPv4
Internet usage

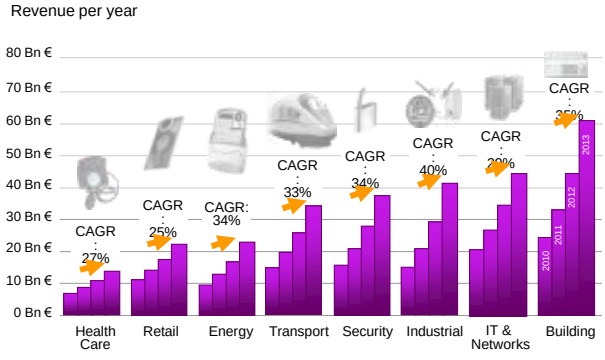


Internet penetration lagging in many regions => growth is inevitable

As networks are growing the negative impact of workarounds introduced to maintain IPv4 will impact more and more

IP is key to enter growing new business segments successfully

Pervasive Internet & smart services market forecast*



* Source Harbor Research: Pervasive Internet & Smart Services Market Forecast (2010-2013)

New services are about to go commercial introducing non-conventional User Equipments in a large scale:

- Smart Grids
- Smart Metering
- Car sensors
- Smartphones
- IP Televisions
- Domotics

IPv6 Key Features and Enhancements

	IPv4	IPv6

Addressing and Routing	• IPv4 addresses 32 bit long
	• NAT is usually used to overcome lack of IPv4 public addresses with its drawbacks
	• Checksum operation
	• Datagram fragmentation
	• Options integrated into the basic IPv4 header
		• IPv6 uses a 128 bit addressing scheme
		  • Improved Routing Efficiency with Hierarchical Address for Aggregation
		  • Improved Multicast support with larger number of Multicast Groups
		  • NAT not required in pure IPv6
		• No checksum
		• Router never fragment packets
		• Six Extension Headers for options
		  • Hop-by-Hop Options, Routing, Fragment, Destination Options, Authentication, Encrypted Security Payload

System Management	• ARP for resolving IP addresses to link-layer addresses • IP configuration: Static, DHCP (Statefull configuration)	• Neighbor discovery • Stateless auto-configuration • Duplicate Address Detection
Security	• IPSec is an extension of the IPv4 protocol • NAT turns security more complex	• IPSec is part of IPv6 basic by default • Security policies more easier without NAT
Mobility	• In Mobile IPv4, the foreign network has a Foreign Agent	• In Mobile IPv6 foreign agents are not needed • Mobile IPv6 uses Routing Header and Destinations Options Header
Quality of Service	• Type of Service (ToS) field in IPv4 header • DiffServ used (DSCP bits from ToS) • DSCP to MPLS EXP mapping used	• Traffic Class field (8 bits) is available • Flow label (20 bits) enables per-flow processing • Routing and Hop-By-Hop Extension headers can be used to signal QoS requirements

IPv6 maturity

Standardization Status

- IPv6 as a standard technology is mature
  - Specified by the IETF (RFC 2460) was first published in December 1998
  - Number of enhancements, extensions defined in more than dozen RfCs
  - Transition mechanisms standardized:
    - 4in6, 6in4, 6over4, 6rd, 6to4, ISATAP, Teredo, TSP, TRT, SIIT
- 3GPP has adopted IPv6, E2E architecture defined in 3GPP Rel 8 and Rel 9
- IMS IPv6 compliant since its introduction of Rel-5 available
- Broad Band Forum adopted specifications WT-177 and WT-187 supporting IPv6
- Work is ongoing on other enhancements:
  - NAT64/DNS64, DS-Lite, GI-DS-Lite

Implementation Status

- PC/Laptop Operating systems and products embrace it:
  - Windows Vista, Windows 7, Windows XP (XP some limitations)
  - Apple Mac OS X, Linux, *BSD, Sun Solaris supports in
- Phones started providing support
  - Symbian S60 supports in general
  - Major device manufacturers have Rel. 8 phones on roadmap
- Networking devices support:
  - Router / networking gear support widely available (Juniper / Cisco etc.)
  - Home-gateways available with IPv6

IPv6 as standard is mature

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IPv6 Transition Tools

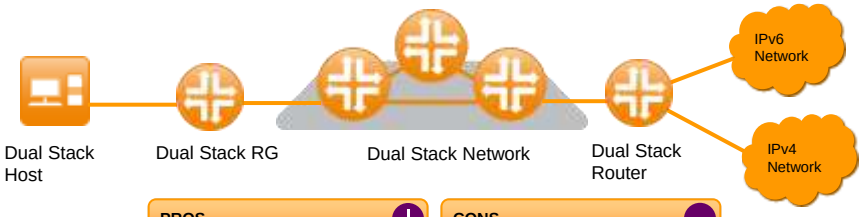
Network Solution	IPv4 Depletion Mitigation	IPv6 to IPv4 Translation

• **Core/Edge Backbone**
  • Dual Stack
  • 6PE
  • 6VPE
• **Access/CPE Network**
  • Dual Stack
  • Enterprise router
  • Residential gateway
  • Mobile User Equipment
  • Tunneling IPv6 over IPv4:
  • 6to4, Teredo, ISATAP, 6rd
	• **NAT444**
	  • End point independent NAT
	• **DS-Lite**
	  • Tunneling IPv4 over IPv6
		• **NAT64**
		  • DNS64
		  • Stateless
		  • Statefull

Source: Source

IP Backbone and RG
Dual Stack

- IPv4 and IPv6 protocol coexist in the same network / network elements
- Dual Stack capable devices supports IPv4 and IPv6 simultaneously in the same interface
- Dual Stack routers support both IPv4 and IPv6 routing protocols and are able to forward IPv4 as well as IPv6 packets
- Enables applications to communicate across an IPv4 or an IPv6 network



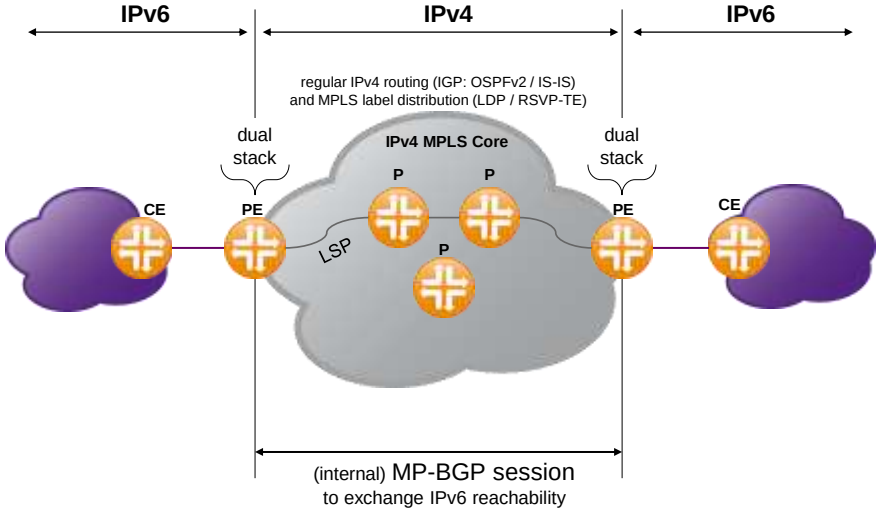
PROS

- Leverage existing network
- Single subscriber management point
- No new boxes introduced
- Extend existing Policy/AAA/ management/LI infrastructure

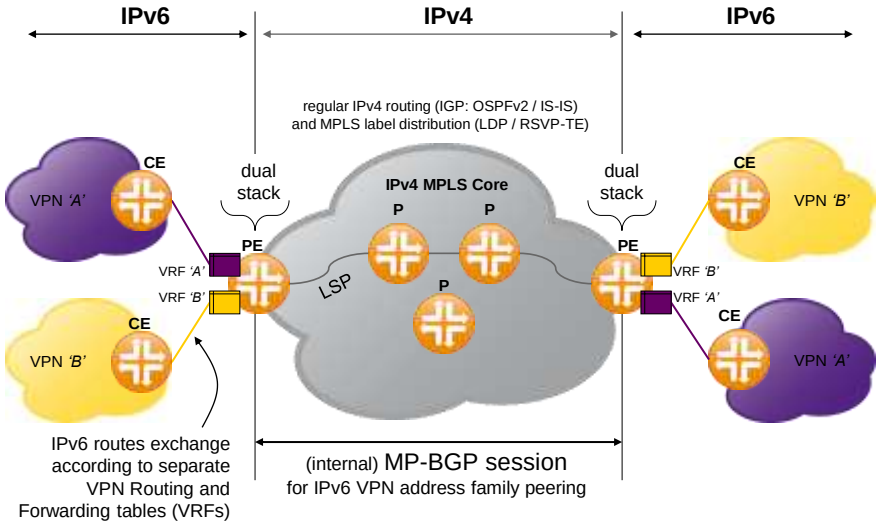
CONS

- Need dual stacked RG and Network that interoperate
- Existing RGs may need to change

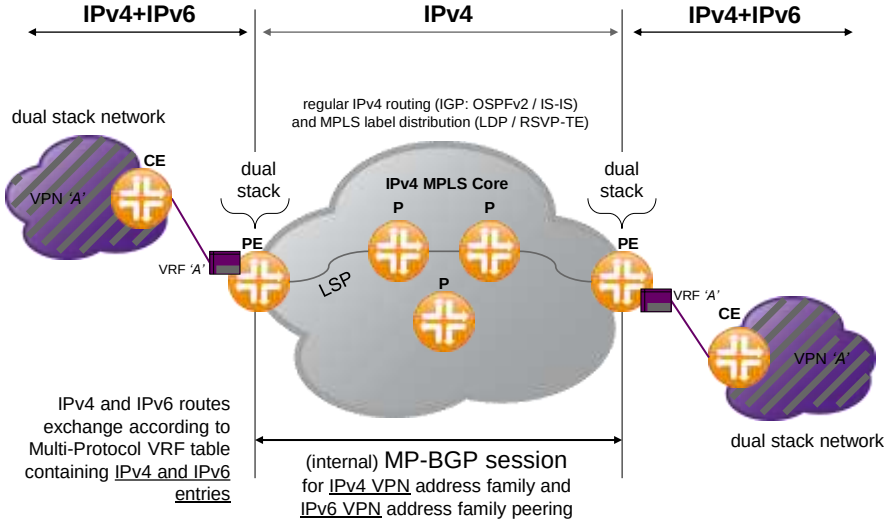
IP Backbone
6PE



IP Backbone
6VPE



IP Backbone
6VPE (v4v6)



6to4 Tunnel

- Router-to-Router automatic tunnel method
- IANA has assigned a special TLA for the 6to4 scheme. The address prefix is 2002::/16
- IPv6 addresses' prefix derived from 2002::/16 prefix and 6to4 Gateway IPv4 address
- 6rd is similar to 6to4, with the key differentiator that it utilizes an CSP's own IPv6 address prefix rather than 2002::/16

PROS

- V6 traffic is transparent to the IPv4 network
- A separate box handles all v6 traffic and directs it to the v6 Network

CONS

- The RG may need SW upgrade
- Does not scale to size of today's network
- Can be initial roll out

NAT444

- Three layers of IPv4 addressing
  - A private IPv4 block within the user network
  - A different private IPv4 block for the user-to-provider links
  - A public IPv4 address on the outside of the CG-NAT
- In NAT444, the same IPv4 address block can be reused within each customer network, and the same IPv4 block can be reused on the inside of each CGNAT for the user-to provider links

  It is this reuse of addresses behind multiple CG-NATs that provides the IPv4 address scaling for NAT444 architecture

PROS

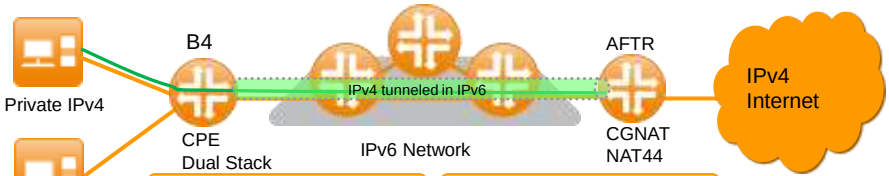
- No need for change the current CPE specification
- All consists of existing technologies. Easier to implement

CONS

- Session states at Core
- Scalability Concern (massive number of sessions)
- Applications are restricted
- Creates regulatory challenges
- Need for ALG functions

DS-Lite

- DS Lite function occurs on CPE
  - If a device sends an IPv6 packet, the packet is routed normally to the IPv6 destination
  - If a device sends an IPv4 packet, the CPE gateway performs the IPv4-in-IPv6 encapsulation, setting the destination address of the IPv6 packet to the address of the DS Lite enabled CGNAT (doing NAT 44)
- Dual Stack Lite Terminology
  - Basic Bridging BroadBand element (B4)
  - Address Family Transition Router element (AFTR)



PROS

- Only one layer of NAT (no dual NAT like NAT444)
- Transit Network can be IPv6 only

CONS

- Requires CPE change
- Same concerns as NAT444 applies in terms of CGN

NAT64

- IPv4 to IPv6 Network Address Translator
- The headers of packets passing between an IPv6-only end system and an IPv4-only end system are converted from one protocol to the other
- A special DNS ALG, known as DNS64 is used:
  - The IPv6 host thinks that it is communicating with another IPv6 system, and the IPv4 system thinks that it is talking to another IPv4 system
  - Neither end system participates directly in the translation process

PROS

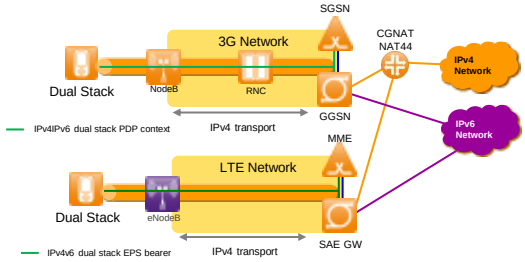
- Allow for IPv4 only sites to communicate with IPv6 only sites
- Statefull NAT provide 1:N translation and keeps bindings state information
- Stateless NAT saves performance

CONS

- Same concerns as with NAT444
- Statefull NAT requires more CPU resources
- Stateless NAT does not save IPv4 public addresses

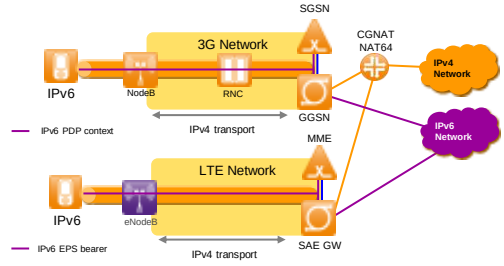
3G/LTE networks and IPv6

Now: Dual Stack plus NAT44



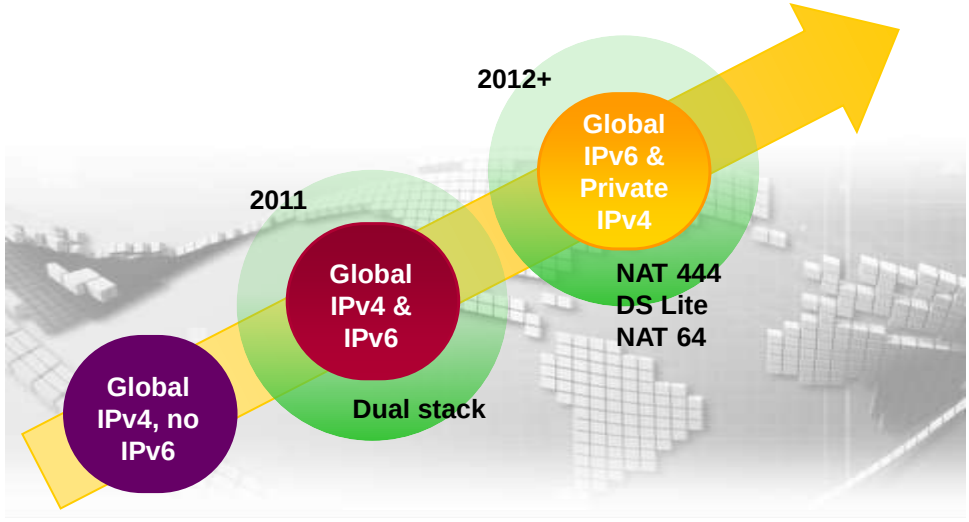
Building Blocks:
- 3GPP Release-9 supports Dual Stack PDP context
- 3GPP Evolved Packet System (EPS, Release-8) introduced Dual Stack EPS Bearer
- NAT 44
- DNS4 and DN6
- DHCP v6

Future: Single Stack plus NAT64



Building Blocks:
- 3GPP and EPS standards as before
- NAT 64 (statefull)
- DNS 64
- DHCP v6

IPv6 Transition Summary



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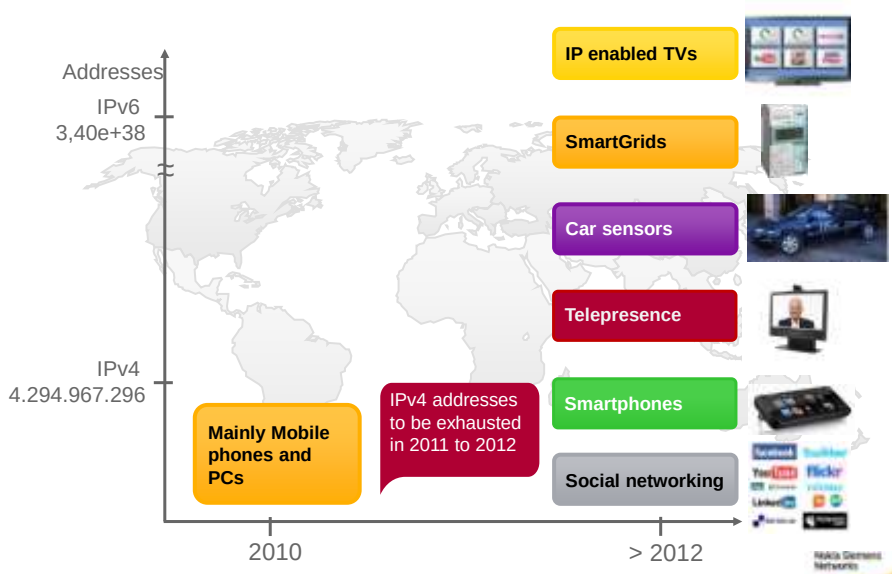
IPv6 scalability
Proliferation of applications and devices



Nokia Siemens Networks brings IPv6 to networks

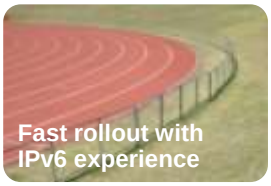
Key driver of standardization

Technical directive: Introduction of IPv6 in all products

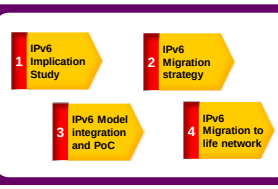
Memberships:
- IETF administrative
- Board of directors ICAAN
- Chairs of RIPEv6
- German IPv6 council

Leading IP-integrator in CSP environment

End-to-end solutions across access, aggregation and core



We migrate leading operator networks to IPv6 today



Thank You