The Mobile Internet: Research Issues

Mícheál Ó Foghlú

(Research Director, Telecommunications Software & Systems Group, WIT)
(Director, Irish National IPv6 Centre)
(Member W3C Advisory Committee)

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Telcommunications Software & Systems Group
ArcLabs Research & Innovation Centre
West Campus, Waterford Institute of Technology
Carriganore
Co. Waterford
Ireland

Telecommunications Software & Systems Group is a world class communications software research centre based at WIT

- **Founded in 1996 by Dr. Willie Donnelly (approx 30 Million EUR in funding 1996-2007)**
- **Partner base of over 150 active funded partners including Motorola, Ericsson, Nokia, Siemens, Lucent, … (Vendors); Vodafone, O2, Telefonica, T-Mobile, Swisscom, BT, … (Operators); LSE, UCL, TCD, … (Academia)**
  - largest Irish EU funded institution for IST FP5/FP6 and for eTEN
  - largest EI commercialisation fund success for a single research centre
- **Balanced portfolio of:**
  - **basic research projects [3] – faculty (5) postdocs (6) students (14)** — **Research Division**
  - **applied research projects [14] – staff (25)** — **Research Division**
  - pre-product development projects [14] – staff (50) — 3CS (Commercialisation)

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Mobile Internet Issues (IP Networks)

IPv4: How long have we got?

- Tony Hain reckons September 2009 +/-1yr (IANA /8 Pool will run out)
  - http://www.cisco.com/en/US/about/ac123/ac147/archived_issues/ipj_8-3/ipv4.html
- Geoff Huston reckons **29-Jan-2010** (IANA /8 Pool will run out)
  - http://www.potaroo.net/tools/ipv4/
    (IPv4 pool exhaustion) N.B. UPDATED THIS MONTH BY 2 YEARS
- In reality this depends on unpredictable factors
  - The policies will probably get tighter
  - There will probably be a rush
  - Something else could blow it apart
- CAIDA (**Cooperative Association for Internet Data Analysis) in UCSD/SDSC** graphs indicate that IPv6 internet in 2005 is as complex as IPv4 internet in 2000
  - http://www.caida.org/home/
- ***That's a wake up call to everyone who relies on the Internet!!!!***

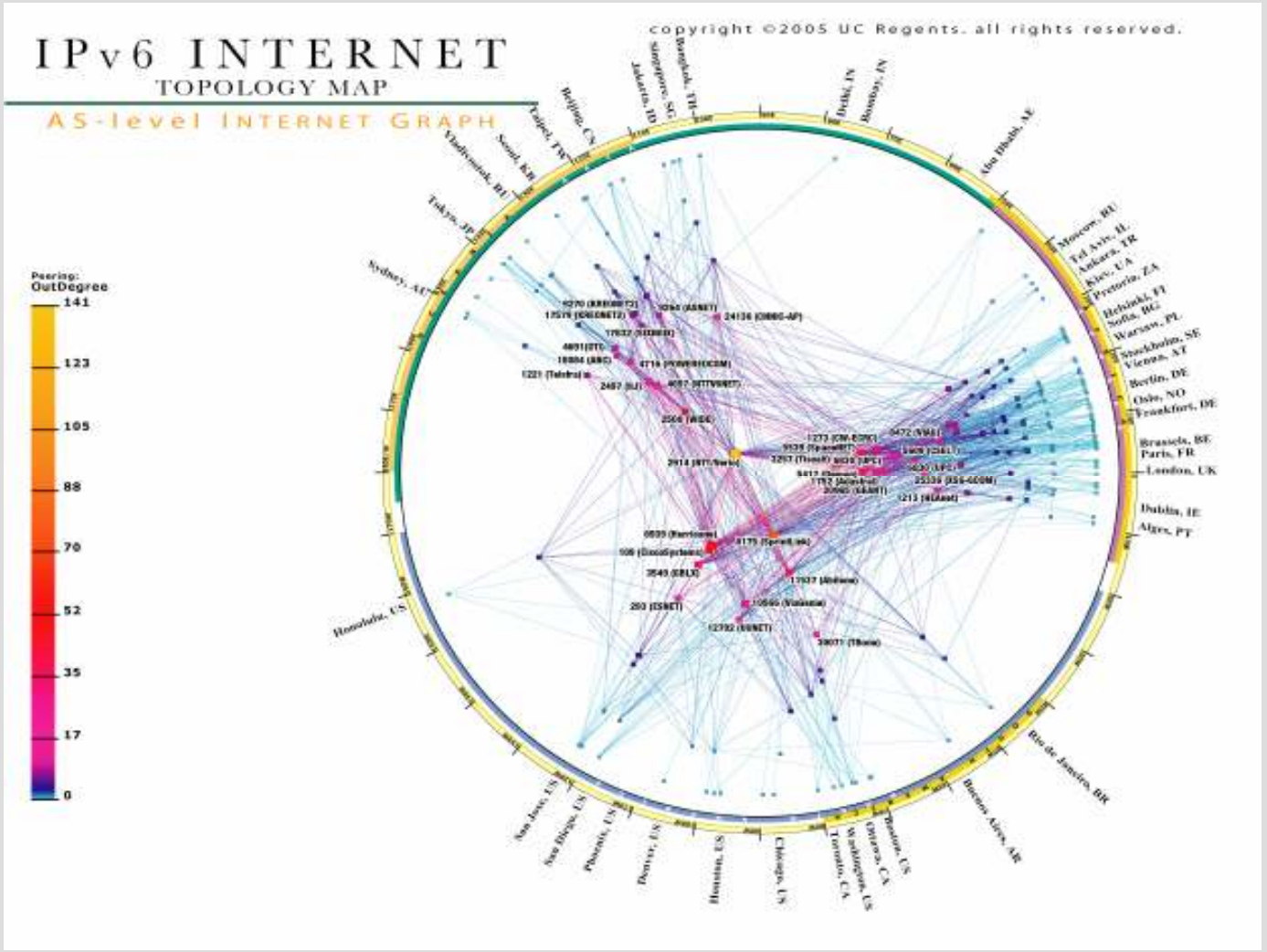
IPv4 Addresses are Running Out

The Internet Protocol Journal - Volume 8, Number 3, September 2005
A Pragmatic Report on IPv4 Address Space Consumption
by Tony Hain, Cisco Systems

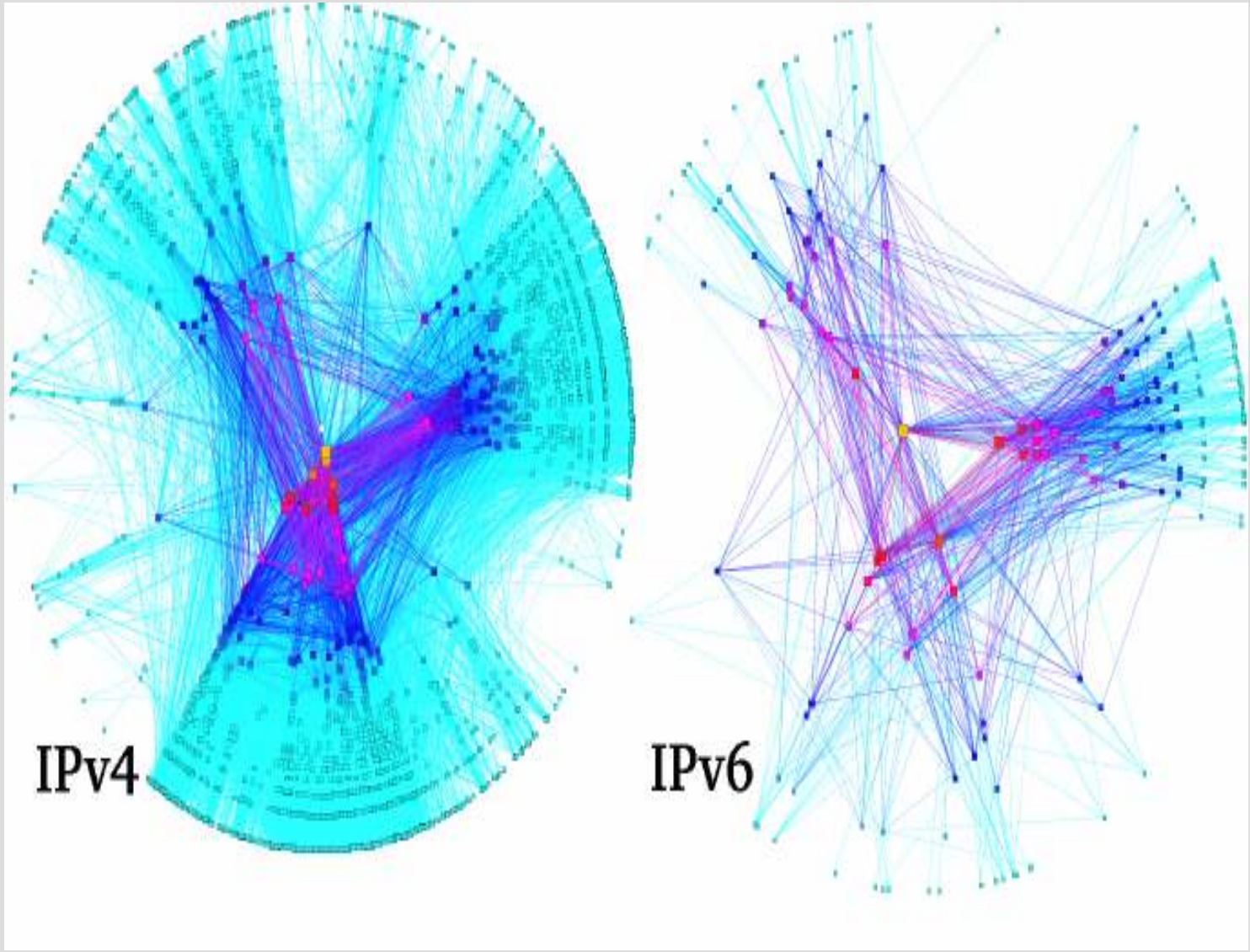
- **Network Address Translation (NAT) and CIDR did their jobs and bought the 10 years needed to get IPv6 standards and products developed. Now is the time to recognize the end to sustainable growth of the IPv4-based Internet has arrived and that it is time to move on. IPv6 is ready as the successor, so the gating issue is attitude.**
- **When CIOs make firm decisions to deploy IPv6, the process is fairly straightforward. Staff will need to be trained, management tools will need to be enhanced, routers and operating systems will need to be updated, and IPv6-enabled versions of applications will need to be deployed. All these steps will take time—in many cases multiple years.**
- **The point of this article has been to show that the recent consumption rates of IPv4 will not be sustainable from the central pool beyond this decade, so organizations would be wise to start the process of planning for an IPv6 deployment now. Those who delay may find that the IANA pool for IPv4 has run dry before they have completed their move to IPv6. Although that may not be a problem for most, organizations that need to acquire additional IPv4 space to continue growing during the transition could be out of luck.**

http://www.cisco.com/en/US/about/ac123/ac147/archived_issues/ipj_8-3/ipv4.html

4th March 2005 IPv6 Topology (CAIDA.org)

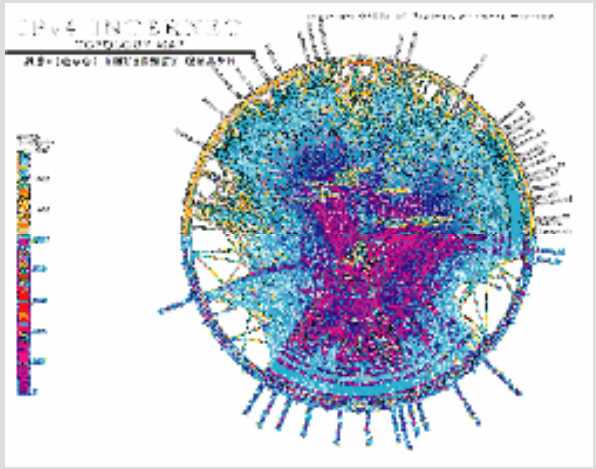


(Mar/Apr 2005) IPv4 and IPv6 Topologies (CAIDA.org)

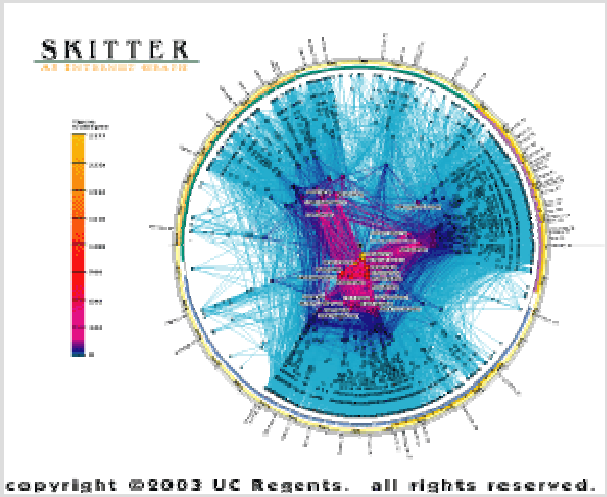


History of IPv4 Topology: (CAIDA.org)
IPv6 2005 = IPv4 2000

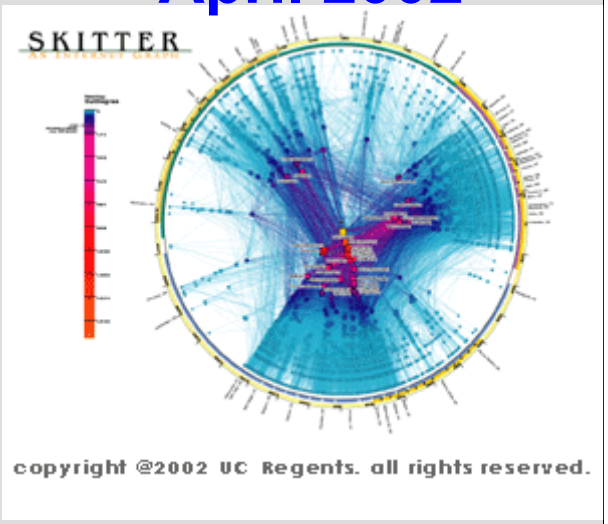
April 2005



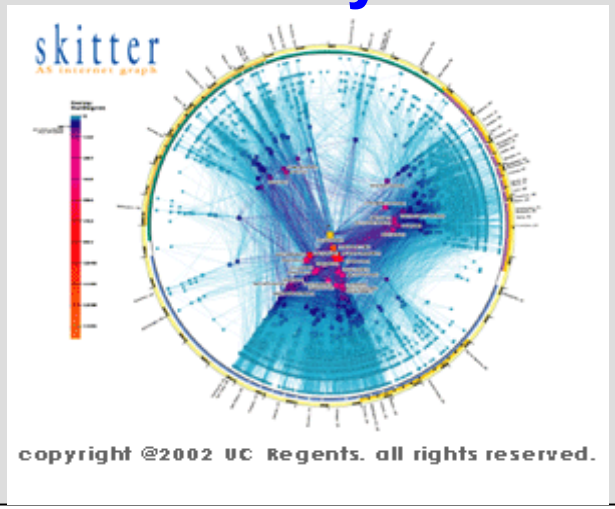
April 2003



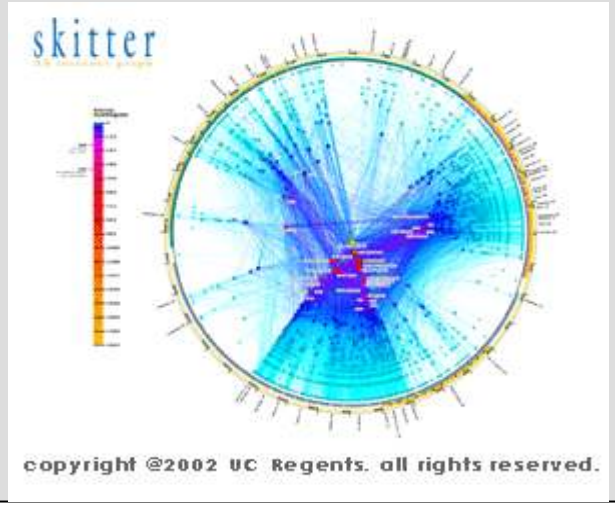
April 2002



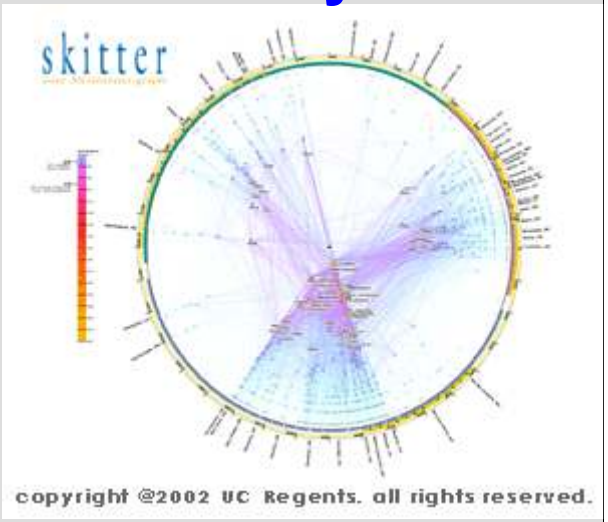
July 2001



October 2000



January 2000



Private addressing has hidden costs

- It breaks the end-to-end assumption
- It hurts security (yes, really!)
- It's extra hassle to avoid leaks
- It's bad news if networks merge
- and translation is CPU-intensive...

IPv6 Services

- **Technically there's no huge advantage for any IP-based services to use IPv6 over IPv4.**
- **The benefits come from the broader infrastructural argument relating to the end-to-end architecture.**
- **This is most important when looking at potential peer-2-peer services such as VoIP**
  - In an IPv4 world you need a SIP gateway and a media gateway to setup a VoIP call using SIP – the media gateway merely allows connectivity through NAT gateways
  - In an IPv6 world the SIP signalling negotiates a media stream that then can flow directly between the two clients
  - This the IMS architecture itself is simplified for many services using IPv6
- **As developers there is no major overhead in developing dual stack applications**
- **Thus those developing services for the next generation internet should develop dual stack applications that support IPv4 and IPv6**

IPv6 Mobility and Multihoming

- **Mobility**
  - Give same service no matter where you are connected
  - Usually IP address indicates way to route packets to you
  - Mobile IP allows for packets to rerouted to your current location (different IP address)
  - Mobile IPv6 technically superior to Mobile IPv4 as most packets can go direct from source to new destination
- **Multihoming**
  - Devices that are connected to more than one network can fail over from one connection to other
  - The same for networks
  - Useful in core network to provide stability
  - Useful in edge networks to provide flexibility (move ISP with automated renumbering)

IPv6 Security

- From a pure technical perspective IPv6 is no more secure than IPv4 – both use network layer security based on IPSec

BUT

- IPv6 mandates support for IPSec (so could be easier to deploy)
- IPv6 allows for the security of the core IP network services (given the mandated deployment of IPSec): DNS, …
- IPv6 forces a re-evaluation of a weak security model based on NAT gateways as a cheap “firewall”
- IPv6 enables a more mature security architecture recognising the internal threats as well as the external ones, and enabling easier perr-2-peer services
- IPv6 does not prevent one re-implementing a system based on traditional edge firewalls and DMZs

IPv6 Security – Hackers' Tool

- IPv6 has already become a favoured tool of hackers
- Often they deploy co-ordination systems leveraging IPv6 that may by-pass traditional IPv4 firewalls

THEREFORE FOR IPv4 and IPv6 SECURITY YOU NEED TO UNDERSTAND IPv6 TO MAANAGE THESE RISKS

- IPv6 networks need an IPv6 security policy (whether re-implementing a traditional edge protection, or developing a different host-protection scheme)
- IPv4 networks also need an IPv6 security policy to make sure hackers do not exploit default IPv6 capabilities in hosts and network elements to by-pass the IPv4 security policy

FOOTNOTE

- One type of hacker activity is much more difficult in IPv6 – port scanning of an entire subnet – this is simply because of the huge size of network allocations (often the size of the Internet for each individual house) – it isn't safe to relay on this however

IPv6 Network Management

- Main advantage is ease of numbering and renumbering
- The router itself advertises address prefixes, so no requirement to maintain DHCP Servers (though they can be used if required for other purposes) – the suffixes tend to be auto-generated so the addresses management of global addresses becomes relatively trivial
- All interfaces have multiple addresses of different scopes, typically a link local and a global (but also allowing multicast)
- Whole network can thus be renumbered by editing main router advertisements
- Security overlaps with network management

Mobile Service Issues

IP Telephony (IMS - Heavy)

- IMS = IP Multimedia Subsystem
- Telecommunications view of a heavy engineering architecture
- Fixed Mobile Convergence (FMC) using IP protocols
  - 3GPP, OMA
  - ETSI TISPAN
- Interfaces to legacy systems
- Well structured QoS and Accounting/Billing
- Unclear how it interfaces to “normal” Internet services
- Basis of 3G networks

IP Telephony (SIP - Light)

- Uses same signalling standard as IMS - SIP
- Metaphor is the SIP is for Internet telephony what HTTP was for distributed software – a simple unifying protocol supporting many types of service
- No need for full IMS architecture if applications are Internet-only (no legacy interface)
- Potential to run on mobile phones especially if WiFi present
- Currently most devices configured to prevent this (so that mobile VoIP cannot run on handsets that have WiFi)
- Much work going on in Java Community process (JCP) to put full stack on mobile clients (e.g. JSR 180 – lightweight SIP stack)
- Works on desktops and PDAs without difficulty (Skype and SIP-based VoIP)

One Web

- **Danger of web devolving in separate silos defined by devices**
- **W3C trying to ensure that principle of one web is maintained**
- **W3C guidelines for MWI, and test suites to test these guidelines**
  - http://www.w3.org/2005/MWI/BPWG/
- **Power of Internet is ubiquity/heterogeneity of network and identity**
  - DNS for identity (domain name)
  - IP for datagrams (IP address)
  - TCP/UDP to provide services (Port number)
  - Simple client/server protocols listening on these ports
  - E.g. email, ftp, web, ….
- **Power of web is ubiquity/heterogeneity of distributed applications**
  - Declarative document-centric paradigm
  - Loosely coupled services
  - Same content from and device
- **Don't sacrifice the generative power of the Internet and the Web in the mobile internet!**

Some TSSG Mobile Internet Projects

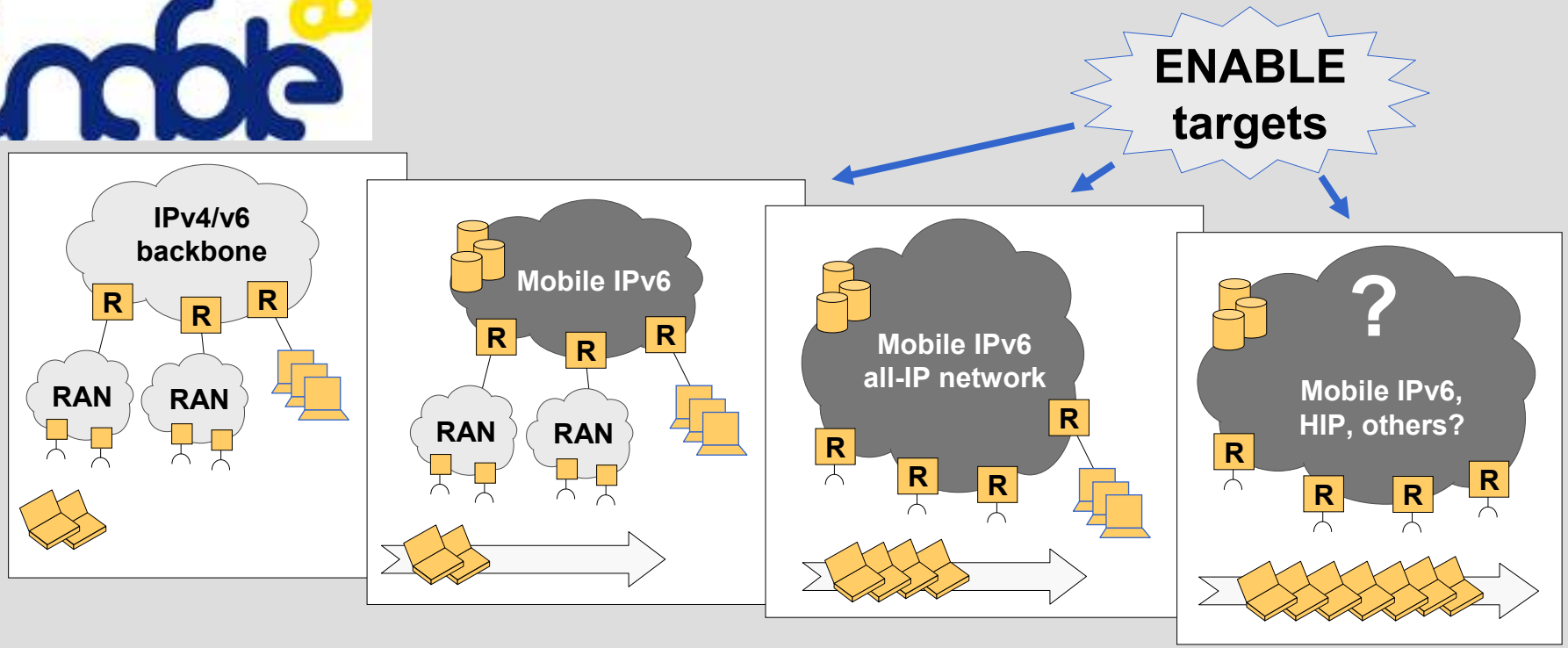
TSSG IPv6 Portfolio: Past

- **Converge (TSR Strand III)**
  - Security, Quality of Service and Accounting for next generation IPv6 services
- **Torrent (EU FP5 IST)**
  - Use of IPv6 for Secure Provision of ISP Services
- **Intermon (EU FP5 IST)**
  - Inter-domain Quality of Service for IPv4 and IPv6 networks and services
- **SEINIT (EU FP6 IST)**
  - Security for next generation IPv6 networks and services
- **IPv6 Cluster (EU FP5 IST)**
  - EU-sponsored coordination activity bring together all EU IST FP5 projects promoting or using IPv6

TSSG IPv6 Portfolio: Current

- **Daidalos I & Daidalos II (EU FP6 IST)**
  - Scenario-based next generation pervasive services based on IPv6
- **M-Zones (HEA PRTLI Cycle 3)**
  - Managed Zones of Smart Spaces – managing next generation pervasive services
- **Foundations of Autonomics (SFI PI Cluster)**
  - Modelling communications networks and services to enable autonomic network & service management
- **ENABLE (EU FP6 IST)**
  - Enabling efficient and operational mobility in large heterogeneous IP networks (built on mobile IPv6)
- **National IPv6 Centre (DCMNR)**
  - Partnered with NUI Maynooth, HEAnet and BT Ireland
- **Irish National IPv6 Task Force (DCMNR)**
  - Promote IPv6 in Ireland
- **Autonomic Management of Communications Networks and Services (SFI)**
  - Manage next generation networks and services

ENABLE: Long Term Vision



Today

Dedicated RANs optimized for specific services

- cellular (2.5-3G)
- Wireless LAN
- WMAN (WiMAX)

Step 1

Integration of heterogeneous RANs to offer efficient and cost-effective ubiquitous mobility

- MIPv6 is the key

Step 2

Smooth migration to an all-IP network architecture

- all services over IP
- MIPv6 with fast handover support

Step 3

Fully mobile Internet

- tremendous growth in the number of terminals
- MIPv6 might suffer its age

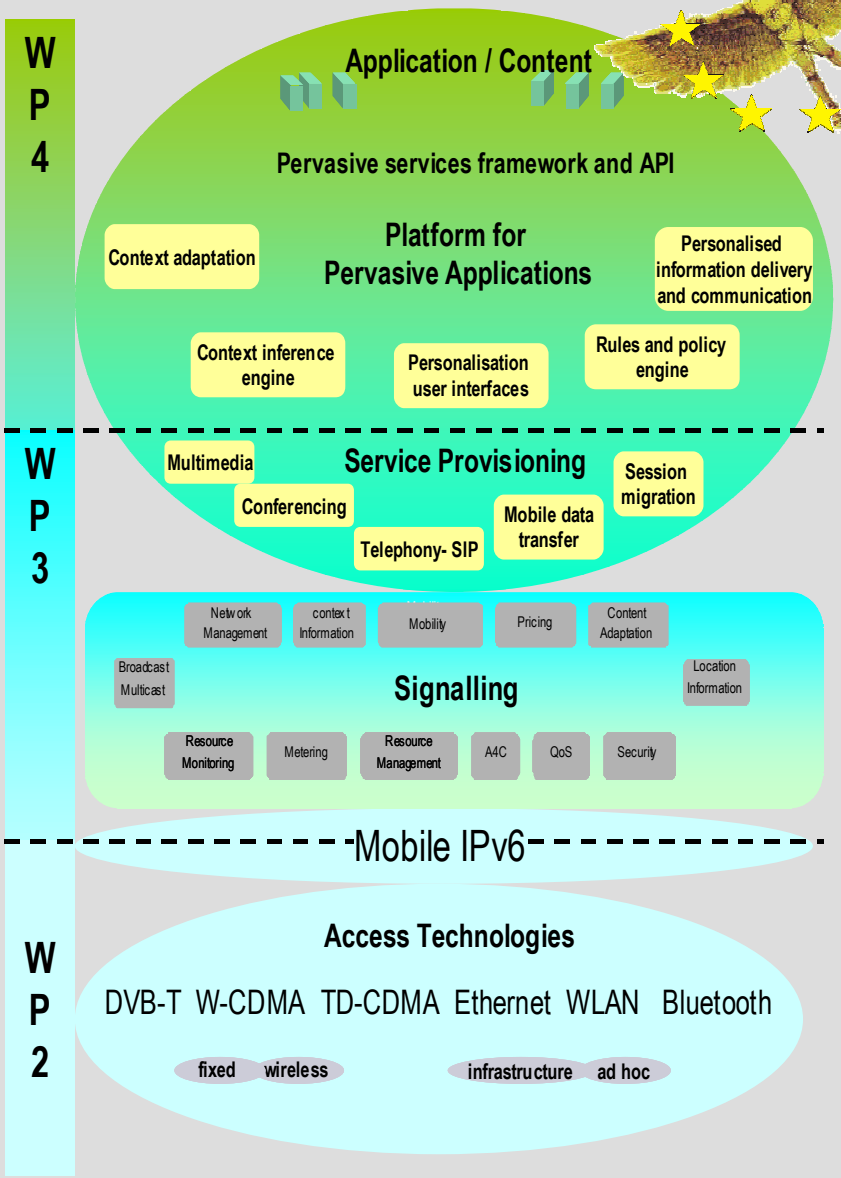
ENABLE: Key Research Objectives (I)

- **Improvement of Mobile IPv6 scalability**
  - **Dynamic provisioning** of configuration data on terminals and HAs
  - **Load-sharing** across HAs
- **Improvement of reliability**
  - Solutions for **HA failover** (no single point of failure)
- **Control of mobility service**
  - **Service authorization** based on a AAA infrastructure
- **Enable offering of "premium" network features**
  - **On-demand and secure activation** of fast handovers, QoS, etc.
- **Integration of Mobile IPv6 in real-life environments**
  - Coexistence with **middle-boxes** (firewalls, VPN concentrators, etc.)
  - Deployment of **Mobile IPv6 in IPv4-only accesses**

ENABLE: Key Research Objectives (II)

- **Analysis of protocols and architectures for long-term network evolution**
  - **Scalability** to an incredibly high number of terminals
  - Optimized support for **terminals with very limited processing and storage capabilities** (e.g. sensors)
  - Deploying **Mobile IPv6 may not be enough in this scenario** and therefore possible long-term alternatives/enhancements must be carefully evaluated
    - **Host Identity Protocol (HIP)**
    - **IKEv2 Mobility and Multihoming (MOBIKE)**
    - **NETwork based Localized Mobility Management (NETLMM)**
    - **Site Multihoming by IPv6 Intermediation (shim6)**

Daidalos: Technology



•Description of technological solution

- Including broad range and types of network technologies, such as fixed and mobile, wired and wireless, symmetric and asymmetric, unicast and broadcast, ad-hoc and infrastructure mode networks
- Mobility and layer 3-paging (IP paging), routing and discovery
- QoS measurements, Resource Management functionalities, IP-QoS to Layer 2 mapping, header compression, adaptive packet forwarding
- Personalised user session: Security, Authentication, Authorisation, Accounting, Auditing, and Charging (SA4C)
- Pervasive computing, intelligent context-awareness and extended personalisation
- Consideration of operator requirements

Summary

Summary

- IPv6
  - IPv6 is important mainly because of problems with IPv4
  - The obvious critical factor is to do with address space (crucial for p2p services over emerging broadband and/or mobile networks)
  - IPv6 offers additional benefits for both security and for mobility
  - Simply put, the management of a planet-wide Internet network is only possible with IPv6
  - This is particularly important for the mobile internet with lots of new connected devices
- Services
  - IP telephony is an interesting area with competing telecoms and Internet views, despite using many of the same protocols
  - The web is the best, but not the only, example of successful Internet services
  - The web works best when it is a single experience from heterogeneous devices, mobile web services should be an alternative interface to the same desktop web services

Contact

Mícheál Ó Foghlú

Research Director

Telecommunications Software & Systems Group

Waterford Institute of Technology

Cork Road

Waterford

Ireland

+353 51 302963 (w)

mofoghlu@tssg.org

http://www.tssg.org

http://www.ofoghlu.net/log (Personal Blog)

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