

IPv6 status and Imperatives

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Acknowledgements

- CAIDA's IPv6 & IPv4 topo maps
- Quantifying the Extent of IPv6 Deployment
 - By Elliott Karpilovsky, Alexandre Gerber, Dan Pei, Jennifer Rexford, and Aman Shaikh. PAM2009
- John King's IPv6 and BT talks
- EU IPv6 survey - RIPE, TNO, GKNS

What is IPv6

- **Successor to current IPv4 Internet Protocol**
 - Under development since about 1993
 - Ratified as Standard by IETF around 2001
- **Principal characteristics**
 - Much more address space – 128 bits instead of 32
 - Mobile IP support mandatory (better than in IPv4)
 - IPSEC mandatory (could be done in IPv4)
 - Better auto-configuration
 - Better multicast
 - More space for flow-control options
 - More efficient processing of header options

Why was it not adopted years ago?

- **Needed complete new suite of programs in each component of the infrastructure and terminal**
 - Virtually all the components are now in place
 - Mostly in dual-stack mode so that either version usable
- **Needed clear concept of how to do transition**
 - This will clear be done via dual-stack
 - Mechanisms for operational transition now defined
- **Needed technical and/or economic reason to move**
 - Killer applications only slowly emerging
 - Address space depletion put off by technical measures and less serious in North America and Europe
 - Considerable concerns of cost/benefit of transition – training, equipment, disruption

Current Status

- Impact of address depletion imminent
- Major studies done on cost of transition
 - E.g. GSA, DoD in US
- Research activities 2000-2006 showed ease of putting dual-stack in the network core and terminals
 - DoD pilots and testbeds 2005-2007
- Most Research networks now dual-stack
- Terminal equipment often has IPv6 1st choice
 - Microsoft since VISTA, IPv6 preferred, goes to IPv4 if needed
 - Mobile telephones have IPv6 since version 6
 - LINUX has long had IPv6 standard
 - Google completely dual stack
 - Though not all applications as complete (e.g. Cisco VoIP)
- Many important policy announcements made

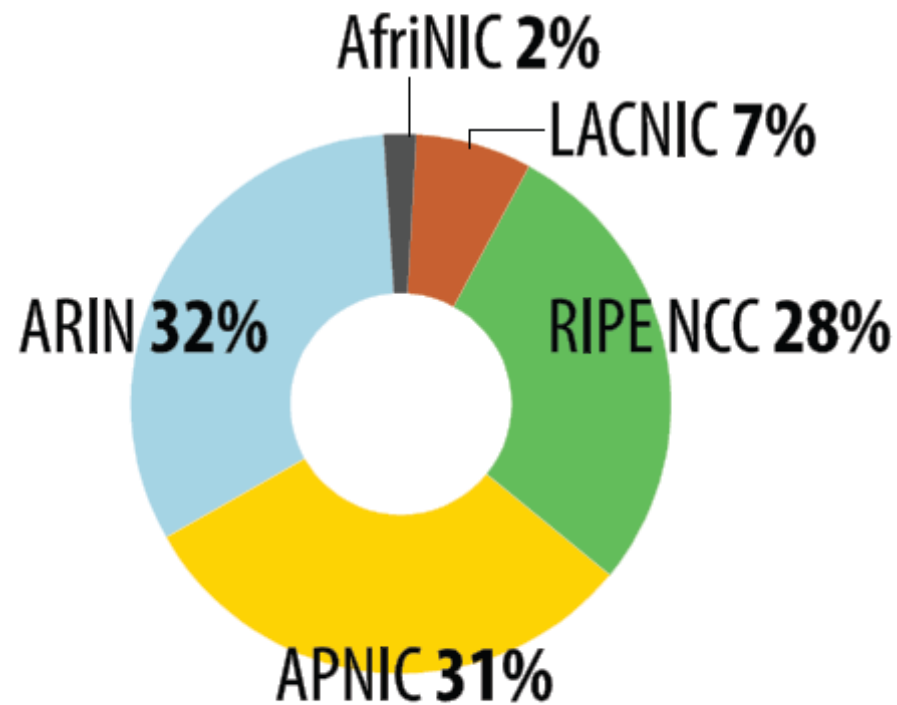
Urgency due to Address Depletion

- **Address depletion stated too often, but now imminent**
 - IANA provides /8s to RIRs; RIRs distribute to organisations
- **<http://www.potaroo.net/tools/ipv4/> has current status**
 - IANA runs out 3/9/11, RIRs 28/8/12
 - Obviously not accurate, but gives idea of imminence
- **Clearly more serious for those with few addresses now**
 - But market in IP addresses may materialise soon
 - Will hinder easy change of suppliers in some industries
 - E.g. mobiles (have agreed to move to IPv6 for IMS)
 - Smart Grids (would require use of private addresses, necessitating re-numbering of meters etc)
 - Many p-p applications (particularly with security)

IPv4 Allocations by Region

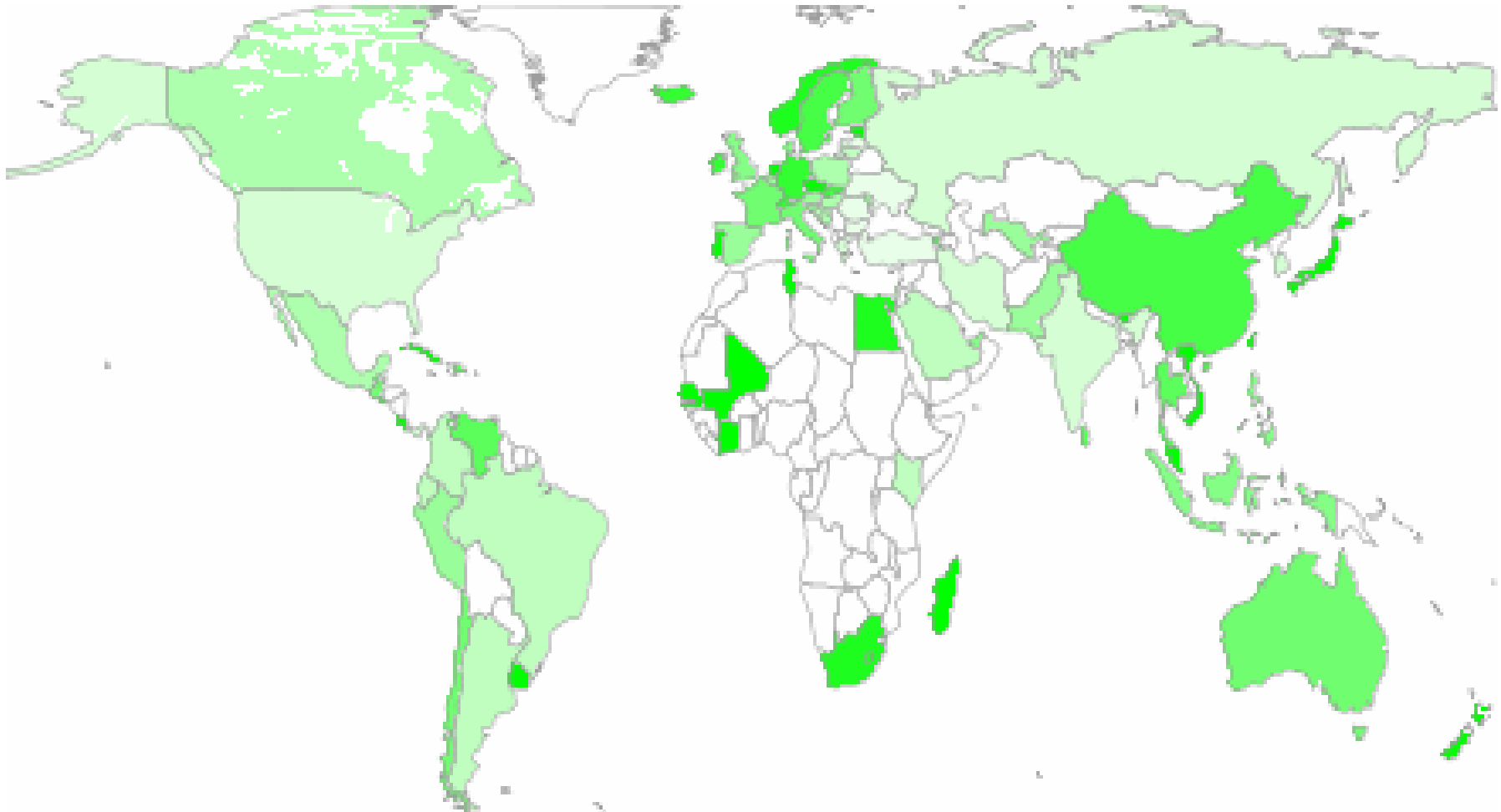
IPv4 Allocations

Cumulative Total as of June 2008



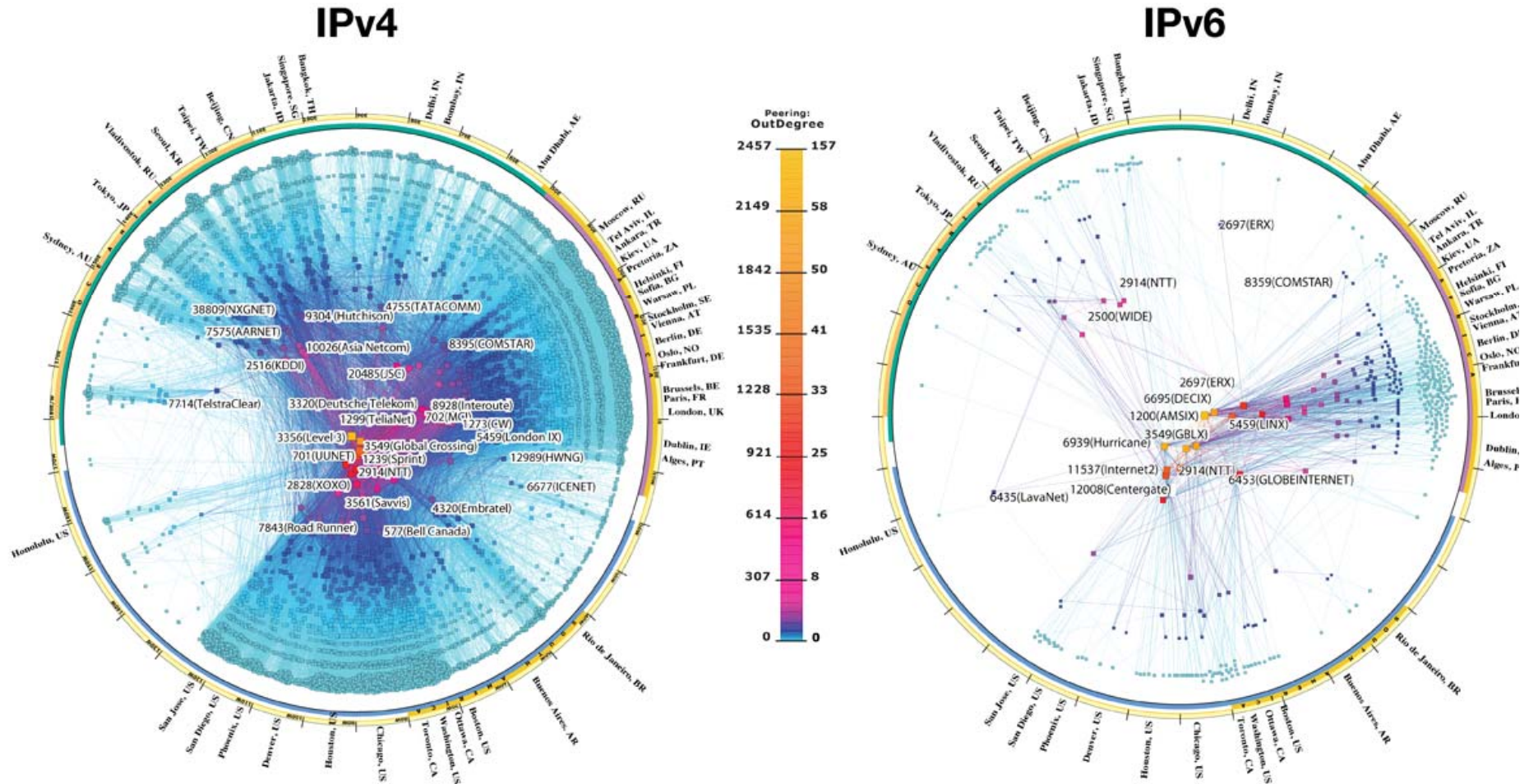
Ratio of IP6/IPv4 AS Distribution 1/09

Dark/medium/light green show >10%, 5%-10%, <5%



IPv4 & IPv6 INTERNET TOPOLOGY MAP JANUARY 2009

AS-level INTERNET GRAPH



US/Global deployment

- **IPv6 traffic: 0.001% of tier-1 US ISP**
 - **Mostly DNS, ICMP and tunnels**
- **Address allocation stats indicate IPv6 uptake**
 - **But too early to draw reliable growth projections**
- **Only 52% (IPv4:87%) of allocated addresses are ever advertised by BGP**
 - **Of these 'use latency' is averages 173 (IPv4: 52) days**
- **Increasing use of tunnels (Teredo) for P2P**
 - **97% of tunnelled traffic is P2P**

US DoD Transition Good Case Study

- **2001 Electronics Board tasked to produce strategy**
- **2003 Came up with broad policy**
 - All new systems from 03 be IPv6 capable, IPv4 Interoperable
 - Support testbed (NAVIPv6) in university
 - Identify a at least 3 major projects that could be IPv6 Pilots
 - Transition 2005 – 2007
 - DISA manage and control all IPv6 address space for DoD
- **Set up labs and testbeds**
 - With ever increasing functionality
- **Set major standards for DoD**
- **Built database of accredited suppliers and applications**
 - Working closely with industry

Japan More General Strategy

- **WIDE Project worked on IPv6 from 2000**
 - Strong involvement from industry
 - Director, Murai, moved to Prime Minister's Office
 - Built IPv6 infrastructure around 2000
 - KAME to provide IPv6 OS around 2000
 - Worked on mobile applications (and cars)
 - Equipped major building in Keio U for energy monitoring and conservation
- **Sony early research activity including 6NET**
 - 2004 stated all relevant future projects would be IPv6
 - Withdrew from effort on in games in 6NET to continue it in Japan
 - Games are p – p and need the IPv6 addresses

European Framework Research

- **Significant pilot network projects 2000 – 2005**
 - 2000-2003 6Init (infrastructure), 6WINIT (mobile apps)
 - 2003-2005 Serious Pilots 6NET (network plus apps), EuroIX (Internet exchanges), Security
- **Training and Applications 2006 – 2009**
 - 2006-2010 6LINK, 6DISS, 6DEPLOY, 6CHOICE
 - 2007-2009 Civil Protection (U2010), 6Power, 6SAT
- **From 2010 no particular IPv6 Projects**
 - But assume that most projects will use IPv6 in their execution
- **Research Infrastructure GEANT dual stack**
 - Most European NRENs also dual stack
 - Very few universities have much IPv6

EC Actively Promoting IPv6

- **2008: European Commission IPv6 Action plan**
 - Propose 25% users be able to connect with IPv6 by 2010
 - Proposes EC and EU e-Gov sites be enabled
- **2009: 1st EU Agency provides IPv6 web access**
 - European Network & Information Security Agency (ENISA)
- **IPv6 EU Deployment Monitoring Survey**
 - By TNO, GNKS Consult and RIPE
 - 610 respondents, including government bodies, ISPs, other technology houses, and education

Survey results: European IPv6 use

- **79% have or in process of getting IPv6 addresses**
 - 97% of educational institutes have IPv6 addresses
- **17% using IPv6**
 - 8% of ISPs are using IPv6
- **30% concerned about IPv4 depletion**
 - Compared with 48% concerned outside the EU
- **Why not deployed yet?**
 - 70% No business case
 - 57% lack of user demand

New Protocols

- Survey indicates lack of interest or understanding of urgency
- Neither organisations nor user understand the impact of protocol progress over last eight years
- IETF has concentrated on IPv6 with new protocols
 - Many could be developed for IPv4, but have not been
 - Examples are improved 6LowPAN (low power protocols), ROHC (Robust Header Compression), MIP6 (mobile users), NEMO (mobile networks), MANEMO (Mobile ad hoc)
- Thus many of the future applications do not really have good IPv4 protocol support

Future Driving Needs for IPv6

- **Know predicting future is a mug's game**
- **Mobile Important driver**
 - IMS needs global access, agreed that it be IPv6
 - As VoIP goes mobile, needs many addresses, not IPv4
- **Smart grids being developed globally**
 - Needs many addresses
- **All peer-peer traffic**
 - Games, VoIP, Conferencing, Supplier push advertising
- **Major interactive automobile services**
 - Again problems of data push if private addresses`

Smart [power] Grid

- **Smart Grids are being developed globally**
 - **Make grid more efficient – potential large cost savings**
 - US estimated \$56-112 Billion saving in 20 years
 - **Earliest examples**
 - 2005: Italy - Telegestore project €2.1B – annual savings €500M per year!
- **2009: US Smart Grid Initiative - \$8.1 Billion**
 - **40 Million smart meters**
 - <http://www.nist.gov/smartgrid>
 - **Smartgrid BoF at IETF76 in Japan, Nov 2009**
 - **Happening fast – standards to be ready by end 2010**
- **Large number of addresses => Need for IPv6**

Emergency Communications

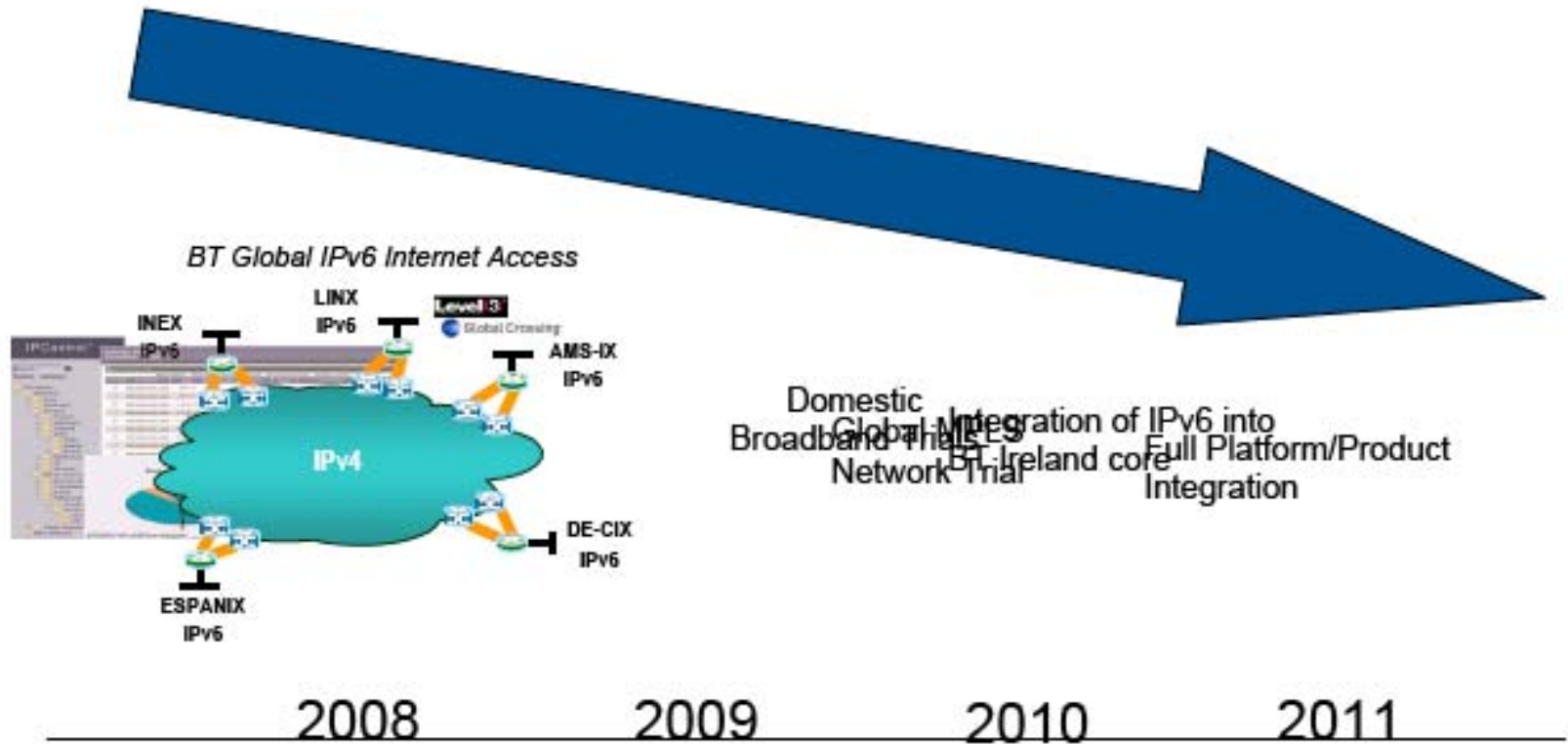
- **U-2010 showed applicability of IPv6**
 - Significant Luxembourg demo with fire, police & ambulance
- **Some of the conclusions of the EC IP**
 - Gateway to TETRA, but much better performance
 - Large-scale addressing of sensor networks
 - Capability of dealing with adhoc network
 - Ability to deal with security of sensor nets and media
 - Addressing size allows federation of different agencies on specific VPNs
 - Autoconfiguration allows easier set up of networks when infrastructure has been destroyed
- **Requires relevant authorities to look at transition questions in the light of current TETRA deployments**

UK Deployment

- **No lead from government**
 - MOD done limited study of protocol, particularly for areas where interoperability with US is vital
 - NHS Network, Digital Broadband report no mention of IPv6
- **BT has been developing IPv6 support**
 - Setup IPv6 research networks
 - UK, Ireland, Germany, Spain
 - Performing limited commercial trials
 - Plans to deploy
 - 2010: Domestic Broadband Trials, Global MPLS trials
 - 2011: Integration of IPv6 into Ireland core network
 - 2011+ Full Platform/Product Integration
- **A small number of UK ISPs offer IPv6**

BT Internet Access Plans

IPv6 Timeline



Plans and Timelines subject to change

The Call to Action

- **IPv6 is coming fast, UK is behind most others**
- **New activities will require it; start now**
 - It is dangerous to ignore it. We need the experience and time to adjust
 - The tools and components are now there
 - As crunch time approaches, IP addresses may become short fairly quickly
- **While long dual stack expected, remember analogue → digital transition**
 - BT Planned 5 yr transition, but reduced it to 18 month due to cost of running two parallel systems.

What can we do?

- **Government should consider IPv6 transition at similar level to further deployment of Internet**
- **Public utilities should consider IP6 impact now**
 - **And start taking appropriate measures**
- **ISPs, mobile and broadband providers should ensure that they have a transition plan in place**
- **Institutions envisaging activities like energy saving and communications should consider the transition**
- **Users should request IPv6 access from their ISPs and broadband providers**

Specific Actions

- All large procurements should envisage IPv6 operation during their lifetime
 - Lack of transition capability should disqualify bids
- E-Government applications should become IPv6-enabled as soon as possible
- Many new large-scale applications should envisage IPv6 from the outset – e.g. smart grids, civil protection
 - IPv6 considerations should be part of all such specifications
- IPv6 training should be stepped up
 - Probably with some interim government funding

What can we do?

- **Government should consider IPv6 transition at similar level to further deployment of Internet**
 - **Particularly with view to new applications like home care, smart grids, emergency provisions**
- **Public utilities should consider IP6 impact now**
 - **And start taking appropriate measures**
- **ISPs, mobile and broadband providers should ensure that they have a transition plan in place**
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Act Now It is becoming late