

IPv6: Overall Deployment Status and Barriers

Jordi Palet (jordi.palet@consulintel.es)

European IPv6 Task Force & Steering Committee

IPv6 Forum, Education & Promotion WG Co-chair

Consulintel, CTO/CEO

Why a New IP?

Only *compelling* reason: more addresses!

- for billions of new devices,
e.g., cell phones, PDAs, appliances, cars, etc.
- for billions of new users,
e.g., in China, India, etc.
- for “always-on” access technologies,
e.g., xDSL, cable, ethernet-to-the-home, etc.

But Isn't There Still Lots of IPv4 Address Space Left?

- ~ Half the IPv4 space is unallocated
 - if size of Internet is doubling each year, does this mean only one year's worth?!
- No, because today we deny unique IPv4 addresses to most new hosts
 - we make them use methods like NAT, PPP, etc. to share addresses
- But new types of applications and new types of access need unique addresses!

Why Are NAT's Not Adequate?

- They won't work for large numbers of “servers”, i.e., devices that are “called” by others (e.g., IP phones)
- They inhibit deployment of new applications and services
- They compromise the performance, robustness, security, and manageability of the Internet

Incidental Benefits of Bigger Addresses

- Easy address auto-configuration
- Easier address management/delegation
- Room for more levels of hierarchy, for route aggregation
- Ability to do end-to-end IPsec (because NATs not needed)

Incidental Benefits of New Deployment

- Chance to eliminate some complexity, e.g., in IP header
- Chance to upgrade functionality, e.g., multicast, QoS, mobility
- Chance to include new enabling features, e.g., binding updates

Summary of Main IPv6 Benefits

- Expanded addressing capabilities
- Server-less autoconfiguration (“plug-n-play”) and reconfiguration
- More efficient and robust mobility mechanisms
- Built-in, strong IP-layer encryption and authentication
- Streamlined header format and flow identification
- Improved support for options / extensions

The European IPv6 Task Force

- The European Commission created the IPv6 TF (2001)
- Goal: Prepare the roadmap for the IPv6 adoption and large scale deployment in 2005



- "Our objective is to ensure that Europe's competitiveness in wireless technology is not jeopardized by the lack of a clear road map towards IPv6," European Enterprise Commissioner Erkki Liikanen said in his opening speech to the IPv6 Task Force.

The move to IPv6 is Global

- January 2002: The TF concluded
- February, March and June 2002:
 - The EC and the Council publish different documents adopting the TF conclusions.
- e-Europe 2005: IPv6, Broadband and 3G
- Continuation of the TF, in a 2nd phase, with the support of the Steering Committee project
- Several European countries (Spain, France, UK, Germany, Switzerland, ...), initiated local activities
- Several TF-like groups across the world, cooperating together

R&D “Arena”: Past & Present

- A few research projects 2-3 years ago (FP5 - IST program)
- Now several Research projects representing investments over **180 MEuros** (90 from the EC)
- Major platforms and networks:
 - 6NET, Euro6IX
 - Available NOW, and interconnected
 - With international peering to Japan, Korea, Abilene (Internet2), ...
 - Also to provide native connectivity for other projects
- Over 40 projects:
 - With IPv6 as the main focus (6POWER, 6QM, 6WINIT, ...), or
 - Using IPv6 for new applications and services (Android, Crumpet, ...)
- 6LINK to support the collaboration in the IPv6 Cluster
- Eurov6 to provide permanent and nomadic showrooms for the industrial and R&D achievements



R&D “Arena”: The Future

- Next IST Program, FP6, clearly supports IPv6, Broadband and 3G as key technologies
 - Over 900 MEuros in the 1st call (4-5 calls)
 - International cooperation expected and highly encouraged
- The IPv6 Cluster facilitated the creation of the “ALL-IPv6-World” WG
 - 20 Activity areas suggested
 - Towards new applications and services
- IPv6 as a key enabler of “Ambient Intelligence”



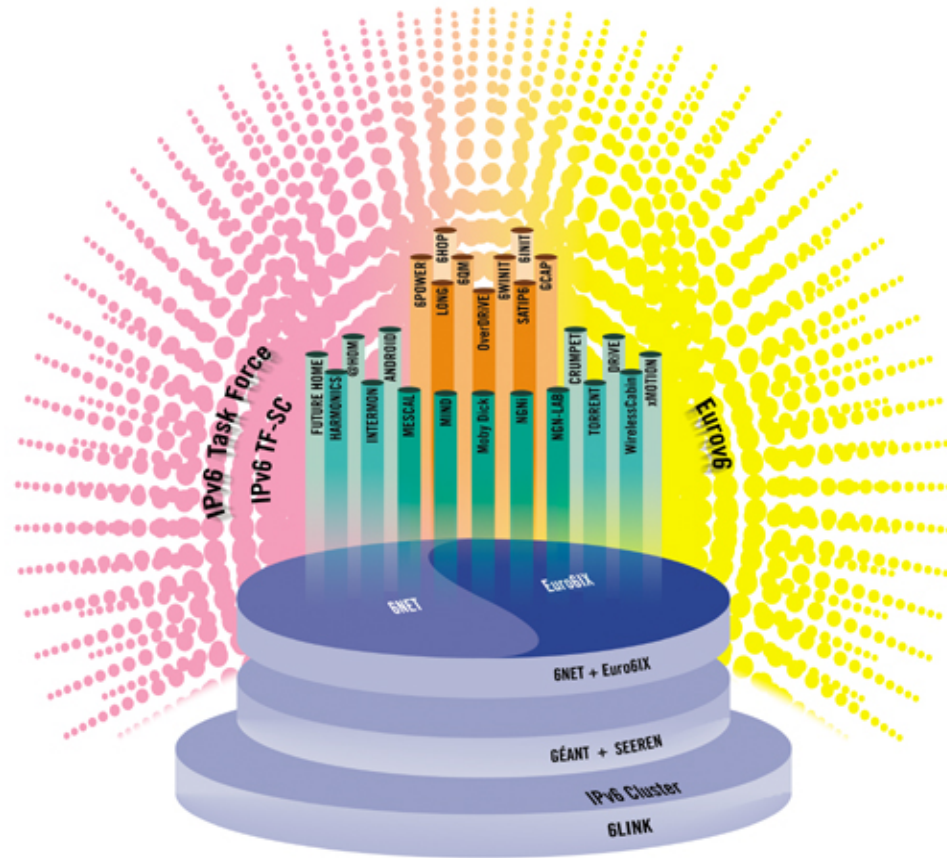
IPv6 Cluster

www.ist-ipv6.org

6LINK
IPv6 Projects United
www.6link.org

The FP5 IPv6 Picture

- Deployment
 - 6NET
 - Euro6IX
- Promotion
 - Eurov6
 - IPv6TF-SC
- Clustering
 - 6LINK
- Others
 - More specific



Big Experimentation Platforms

- In Particular
 - 6NET and Euro6IX
 - Total budget: 34 M€
 - Total EU funding: 18 M€

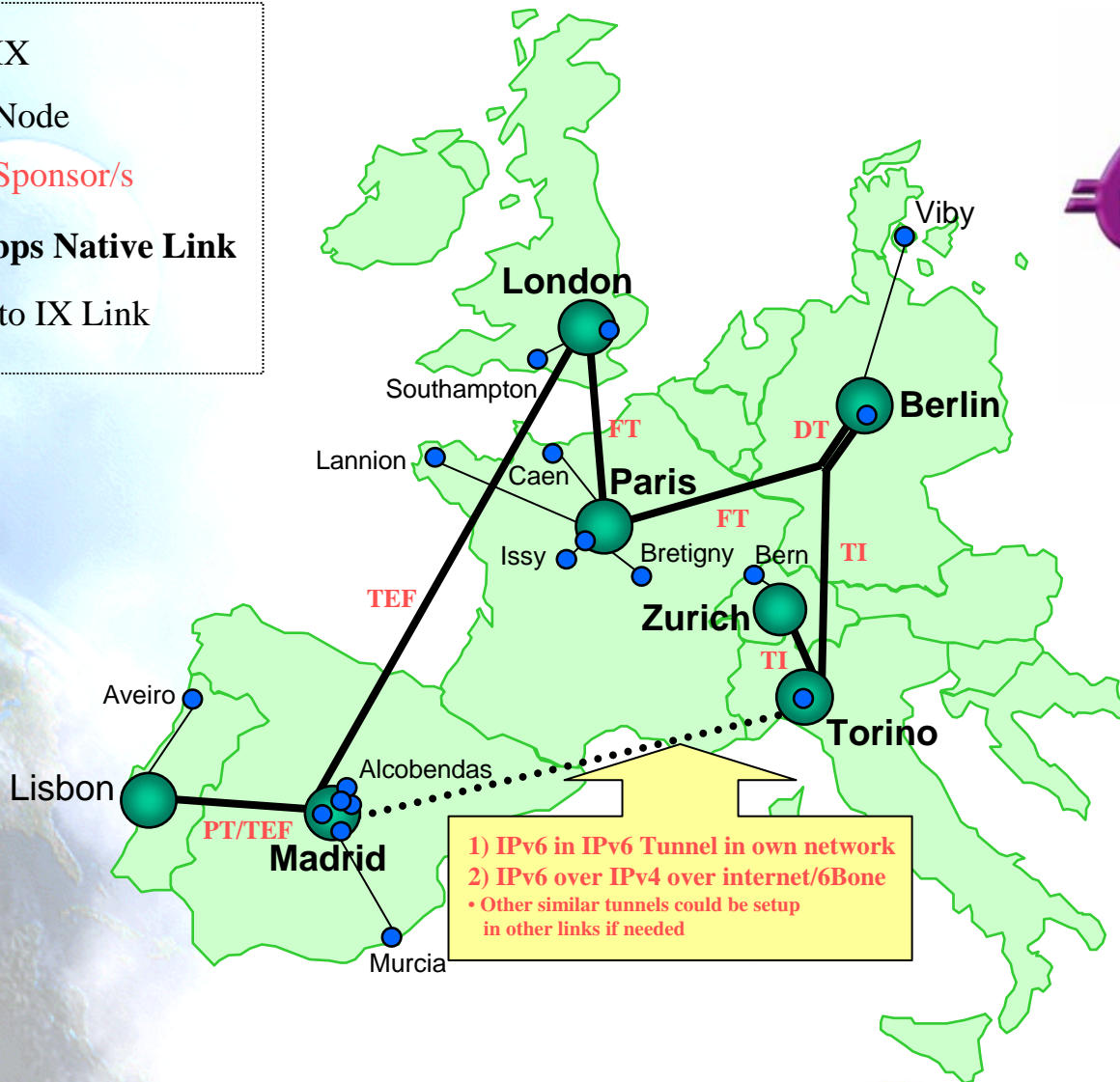
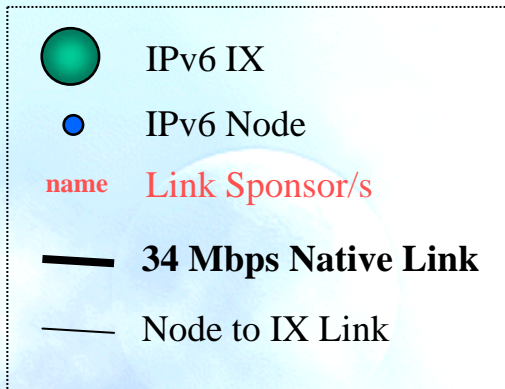


<http://www.6net.org>



<http://www.euro6ix.org>

Pre-Commercial Trials



European IPv6 TF

Achievements

- Over 12 TF kicked-off during 2003
- Participation from key industry, education, research and government groups
- Support from EC and national governments
- Awareness and working meetings
- Different focused working groups
- Press releases and articles
- Some entities (public and private) asking for IPv6 in their acquisitions/tenders
- IPv6 considered for funding in R&D programmes
- IPv6 in IXs and DNS root mirrors
- Some ISPs with IPv6
- National Research and Education Networks connected to GÉANT with IPv6 and offering IPv6 services to their community
- Local web site, ftp, mail exploders and archives
- Trials in different business sectors

Barriers

- Lack of concrete business models
- Lack of customer demand (customers/consumers want services not protocols)
- More awareness required
 - Press info about the requirements for acquisitions/tenders
- Lack of official commitment from governments
- Lack of strategic recognition of the importance of IPv6
- Lack of new IPv6-ready applications and services
- Lack of European Industrial leaders
 - Big Telcos not moving
- Lack of simpler and clearer technical answers
- Lack of funding for the National Task Forces activities
- Lack of funding for the take-off of the ISPs and industry in general
- Lack of benchmarking of the real deployment and the bigger picture

Future

- Continue and strengthen the work and cooperation of the National and EU IPv6 Task Forces, defining National and European recommendations
- Focus on deployment and applications
- Continue the awareness and dissemination activities, communicating on best practices
- Update the national Task Force web sites and create a EU IPv6 web portal
- Promote the creation of a centre of excellence, which can be an independent reference point for those wishing to design, build, develop or deploy IPv6 products
- Convince the public and private organizations to demonstrate their commitment, demanding IPv6 in any procurement
 - Connect universities and schools natively
- Arrange for the key public sites to be accessible with IPv6
 - Government sites
- Gather more potential industrial actors (SMEs, integrators, ISPs, WISPs, etc.)
- Work on “business case” examples
- Study a detailed deployment roadmap

And Moving ... To Commercial

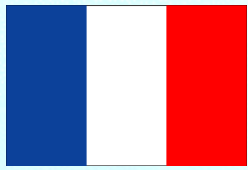
*** With Contributions from Several
European Telcos and
National IPv6 Task Forces



Portugal



- IPv6 Portuguese Task Force created with the support of UMIC (Governmental entity responsible for incentive the innovation in Portugal and follow the eEurope 2005 European program).
- Strong involvement in R&D activities (Portugal Telecom Inovação).
- No ISPs starting IPv6 commercial operation or public trials in Portugal. No publicly known dates defined to start.
- GigaPIXv6 (public IX operated by FCCN) started operation several months ago.
 - FCCN, Vodafone Portugal, Telepac (Portugal Telecom Group) and other small regional operators (NFSi).
- Some companies are performing small internal trials with several access networks. Telepac: Internal trial with ISDN and preparing for ASDL.
 - Commercial around 2004
- Other companies from PT Group investing in IPv6 training.
- Documentation being written for high level instances on PT, pointing to start thinking seriously in IPv6.



- Strong participation on the France IPv6 Task Force
- Deployment of internal IPv6 network between sites of FTR&D since 1998.
- Deployment of a national scale IPv6 and dual-stack high bandwidth network within VTHDv6 project (national research project).
- Experimentation of a WLAN IPv6 network within Strasbourg University campus.
- Strong involvement in R&D activities
- Operational: Opentransit
 - France Telecom's carrier has deployed an IPv6 native backbone, in order to help customers to move forward RIGHT NOW.
- IPv6 in 2 IX



Italy



- IPv6 Task Force being kick-off next October
- Early participants in IPv6 standards and R&D
- Strong involvement in R&D activities
- ngnet.it Telecom Italia initiative
 - More than 30000 experimental users to Tunnel Broker service
 - 2000 users connected together
- Applications services:
 - IPv6 only IRC server with more 1000 users connected together
- Other Telcos starting to be involved in IPv6 in Italy.
 - Wind
 - Edisontel
- IPv6 in the two main IX
 - Milan Internet Exchange
 - NAMEX (Rome)



Spain

- Strong participation in the Spanish IPv6 Task Force, supported by the Ministry of Science and Technology
- Strong involvement in R&D activities
- IPv6 in two IX
- IPv6 in public tenders
- June 2004, several important web sites will be enabled
- DNS root server mirror moving to IPv6 (Espanix)
- 1st Newspaper offering all the contents in IPv6 (El Mundo)
- 1st Hotel of the World with IPv6
- 1st ISP already commercial (arsys)
- Several ISPs starting soon ...
- LMDS service with IPv6 soon ...
- WLAN service with IPv6 soon ...
- NAP with IPv6 soon ...
- Telefónica Data:
 - Summer response: Transit Pre-commercial pilot, with several customers. Feel more interest, but still no real business. May be after 2004.
 - Actual situation: Commercial service since 15th January 2004 !!!
 - Enterprise customers
 - International carrier/transit network



Switzerland



- Swisscom Mobile:
 - Plans for GPRS/UMTS, first testing for WLAN.
 - Commercial expected in 2004 (WLAN) and 2005 (UMTS)
- Swisscom Enterprise Solutions (ISP for business customers):
 - RIPE IPv6 /32 since Sept 2002, test environment with native IPv6 connectivity to Euro6IX since June 2003.
- Bluewin (ISP for residential customers): RIPE IPv6 /32 since May 2002, test environment.
 - Commercial expected 2004/2005
- Swisscom Innovations (Swisscom R&D):
 - 6Bone TLA since 1997, testlabs since then, operational Intranet with IPv6 support since April 2003.

Others ...

- Germany
 - Deutsche Telekom and T-Systems are working on IPv6 in projects (European projects, Customer projects) for several years.
 - Deutsche Telekom has done an IPv6 Showcase with industry partners and is founding member of the IPv6 Forum and the European and German IPv6 Task Force.
 - T-Systems, the system integration subsidiary of Deutsche Telekom, is offering IPv6 in customer projects on a project basis.
- UK
 - Pre-commercial trials by a number of leading Telco's, ISPs, IX, corporations, SMEs and individuals.
 - BT is heavily involved in R&D, the IPv6 Forum and IPv6 Task Force.
- Several European IXs, some ISPs.
- Global carriers with presence in Europe:
 - Global Crossing, NTT/Verio, Telia. A few others working on it, but not public info.
- Other countries also involved, including Belgium, Ireland, Austria, Denmark, Sweden and Netherlands.

North America: The DoD Announcement

- Press conference with John L. Osterholz, Director of Architecture and Interoperability, Dept. of Defense.
 - We are aggressive in our goal, but is achievable.
 - At the end, IPv6 will reach to each individual soldier.
 - Today, everything has a router, even the helicopters. These will be with IPv6.
 - Total IP budget is 30-35 billion (with b) USD, conservatively speaking. Cost of the convergence with IPv6 is being worked out right now.
 - Feedback with contractors. A few with a negative reaction, but number of them are very happy to work in the idea of pilots.
 - Is needed to provide IP connectivity to soldiers in the field. Will do also convergence with VoIP.
 - Hundreds of IP addresses with every soldier. The big issue are still the batteries!
 - The DoD isn't comfortable leading this technology, we don't want to have a commercial role, but we do it because we recognize that the products and technology is here. IPv6 community talked to us and we heard the message.
 - Within 6 years satellites will provide IP capability at Gigabit speeds, and that will help the convergence with wireless. Is the transformation of communications. Software defined radios are here.

Rest of the World

- Already deploying IPv6 in some countries
- Looking for how to extend IPv6 deployment to the rest
- Aug. 2003, Seoul, IPv6 Summer Retreat
 - Kicked off the Asia Pacific IPv6 Task Force, in cooperation with EC IPv6 TF
 - www.ap.ipv6tf.org
 - Oct. 20th 2003, Kuala Lumpur, AP IPv6 Task Force meeting
- 1st /30 delegated by APNIC ... that's real large scale deployment !
- March 30th 2004, Montevideo, LAC IPv6 Task Force meeting

EC IPv6 Task Force



European Commission
IPv6 Task Force

<http://www.ipv6tf.org>

The Global Effort

- Now the Task Force is not just Europe !
- Is a “global” issue, with strong cooperation with the rest of the world
 - Global R&D
 - Global policy
 - Global deployment
 - Global business
- Global deployment already started
 - See Japan !
 - IPv6 Applications Contest just started
(<http://www.ec.ipv6tf.org/PublicDocuments/030203apc-eg.pdf>)

IPv6 TF-SC



IPv6 TASK FORCE
—Steering Committee—

<http://www.ipv6tf-sc.org>

IPv6 TF-SC: Objectives

- To perform all required actions aiming at the enhanced coordination and continuation of the work performed within the IPv6 Task Force with an enlarged participation and renewed mandate as the IPv6 Task Force 2nd phase.
- To provide a regularly updated review and plan action on the development and future perspectives of IPv6 in order to coordinate European efforts on IPv6.
- See <http://www.ec.ipv6tf.org/in/i-finalreports.php>

IPv6 Project Cluster



IPv6 Cluster

www.ist-ipv6.org

6LINK
IPv6 Projects United
www.6link.org

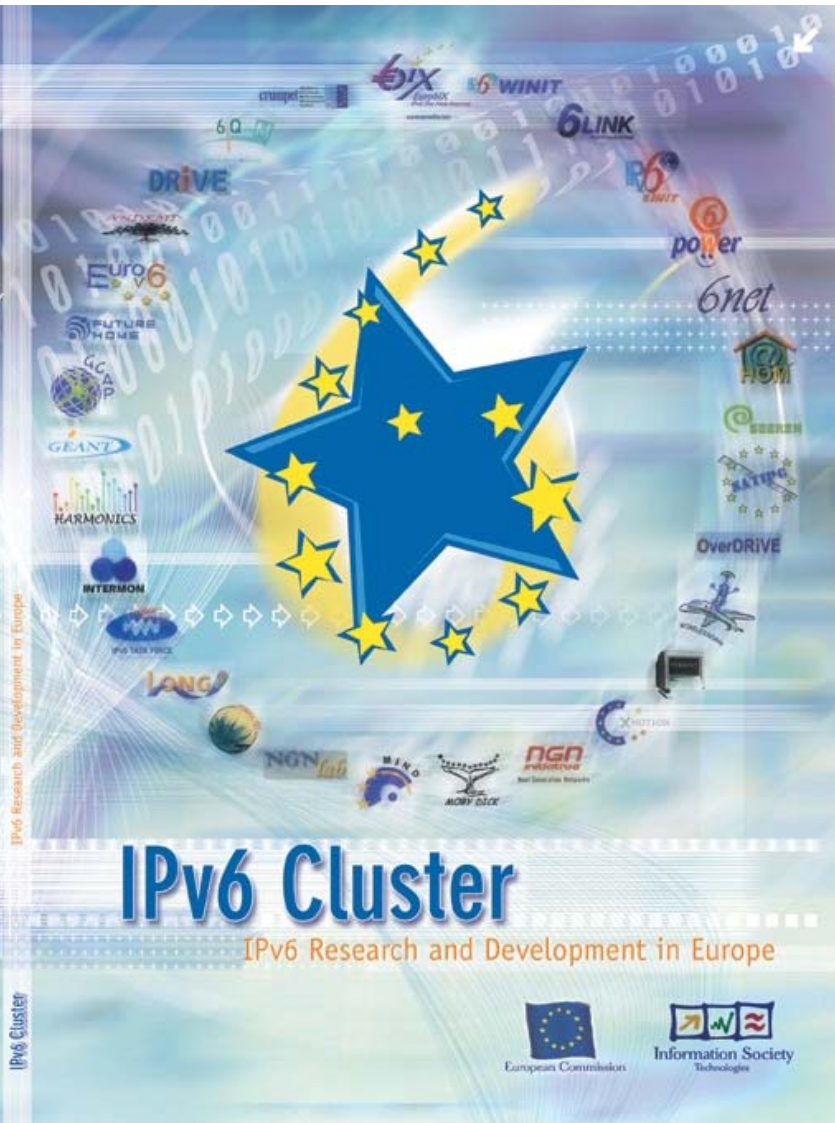
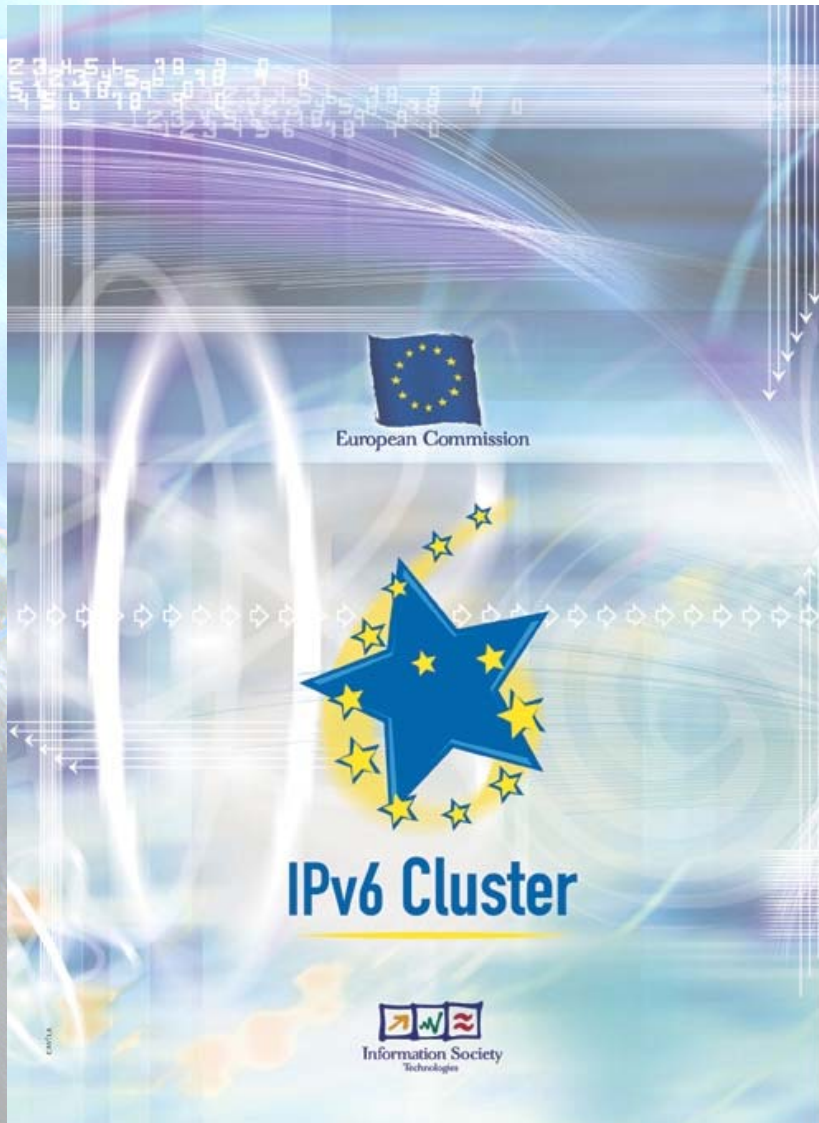
6LINK: Objectives

- Consensus building
 - IPv6 development
 - IPv6 deployment
- Dissemination
- Exploitation of consensus
 - Common trials
 - Coordinated input to standards development

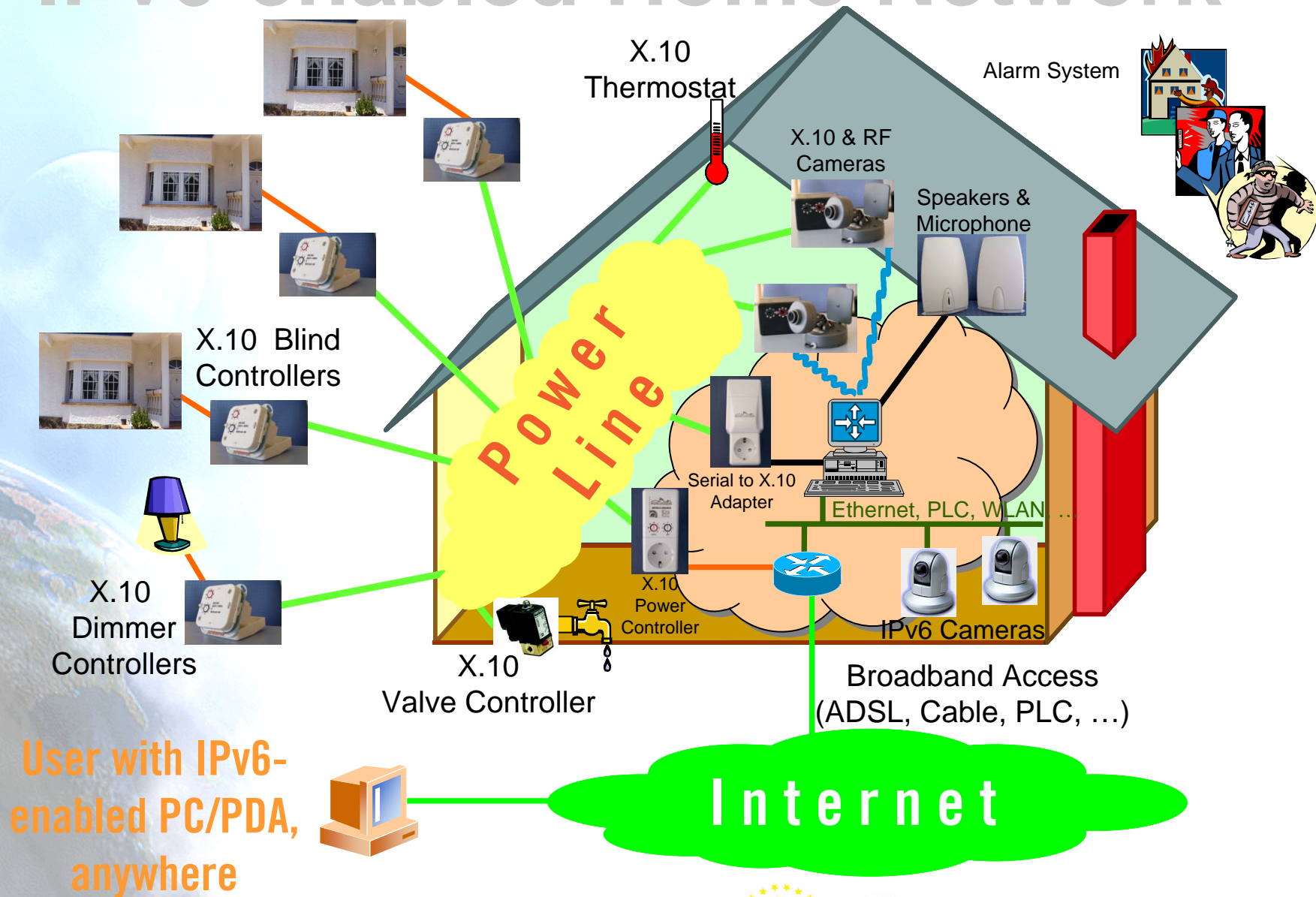
IST IPv6 Cluster

- www.ist-ipv6.org
- Register and get:
 - Newsletter (every 2 months)
 - Standards report (every 4 months)
 - Applications Database
 - Publications
 - Contact with IPv6 EU Researchers

IPv6 R&D in Europe



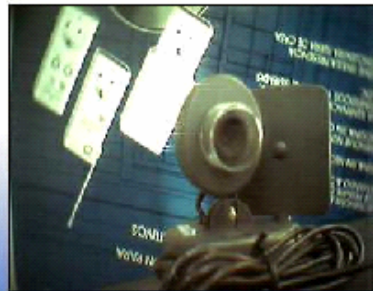
IPv6-enabled Home Network



The Demonstration

Salir

CÁMARA



C2 camera 2

CONTROL DE DISPOSITIVOS DEL HOGAR



Usuario: consulintel

Martes, 23 Diciembre 2003

Código	Nombre	Estado
A1	on/off	Encendido
A2	dimmer	Encendido
B1	persiana 1	Encendido
B2	persiana 2	Apagado
B3	persiana 3	Encendido
C1	camara 1	Encendido
C2	camara 2	Encendido
C3	camara 3	Encendido



Mandos de control



Encender



Apagar



IPv6-enabled Home Appliances

- There is an incredible market for any kind of IPv6-enabled appliances, with technologies like PLC and WiFi:
 - Cameras
 - Audio
 - Alarm systems
 - Sensors (intrusion, smoke, gas, water, ...)
 - Controllers
 - Dimmers
 - Switches
 - Electro-valves
 - Door-locks
 - Temperature
 - Pet feeders ;-)
- What about the kitchen and the living room ?
- Ambient Intelligence is HERE !

Are you missing your piece of the cake ?

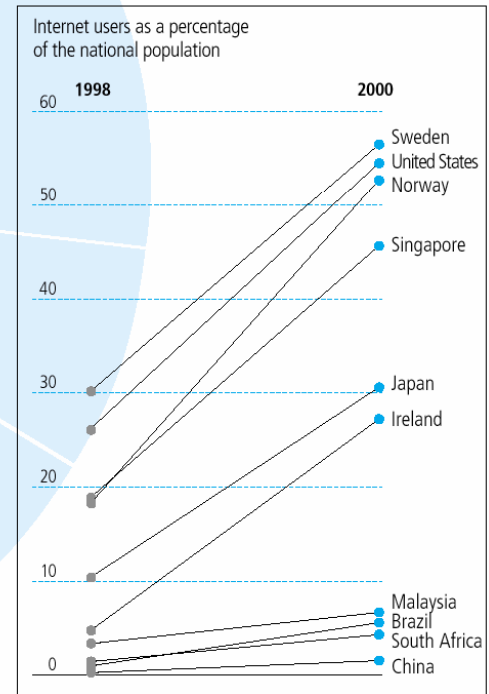
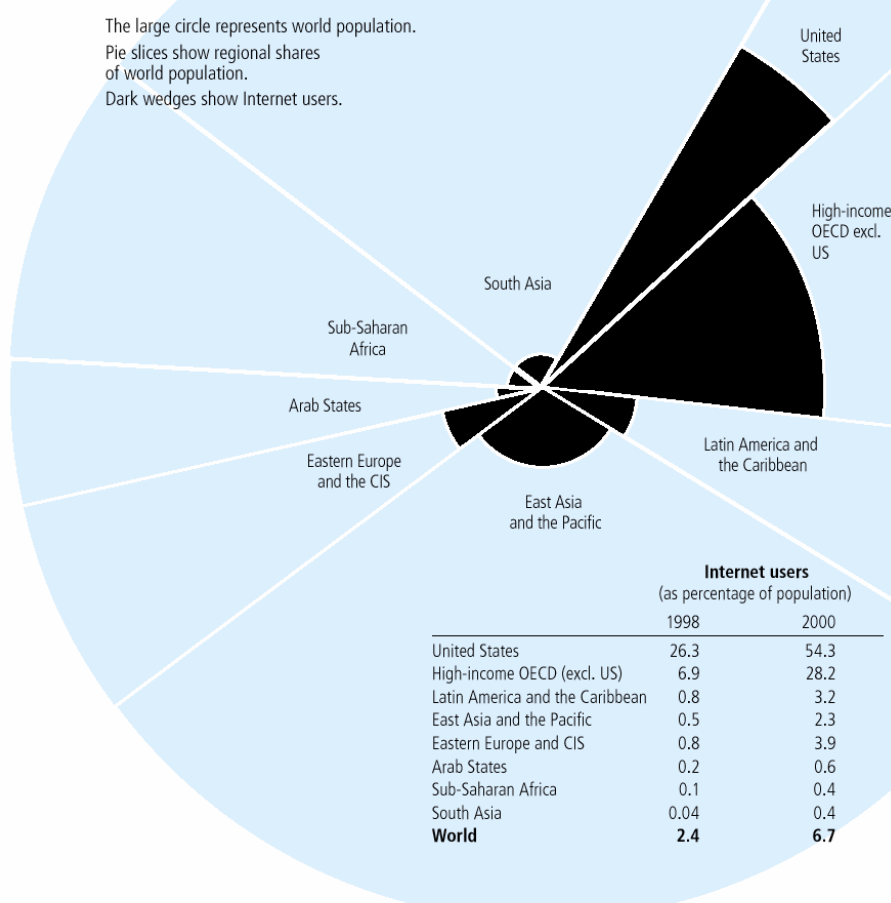
The Digital Divide

FEATURE 2.3

UNEVEN DIFFUSION OF TECHNOLOGY—OLD AND NEW . . .

INTERNET USERS—STILL A GLOBAL ENCLAVE

The large circle represents world population.
Pie slices show regional shares
of world population.
Dark wedges show Internet users.



Source: Human Development Report Office calculations based on data supplied by Nua Publish 2001 and UN 2001c.

- <http://hdr.undp.org/reports/global/2001/en/>

Internet Figures

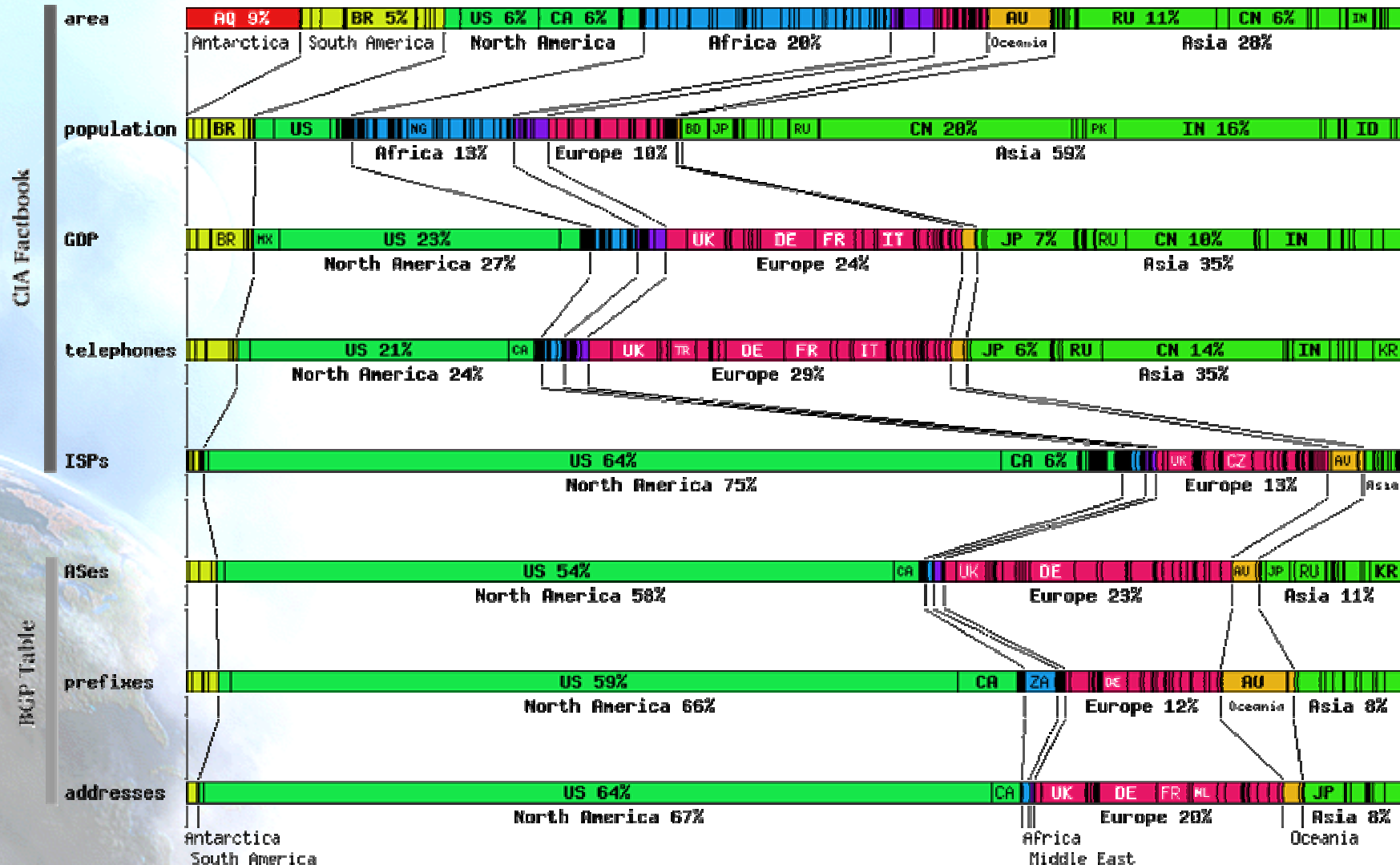
- United Nations studies suggest:
 - US has about a 60% share of existing Internet resources
 - Europe a further 20%
 - The other rich countries taking at least half the rest
- The distribution is much more skewed than for telephony, and certainly more skewed than for electricity distribution, which is available at least in the permanent buildings of almost every city in the world.
- While it is true that some countries have low electricity coverage, and that PLC is not the solution for the entire digital divide problem, it has the potential to vastly extend Internet coverage without additional "last mile" cabling.

Teledensity (example)

- China:
 - 9 phones for every 100 inhabitants (low copper/phone penetration), but 32.1 TVs (better electricity coverage).
- Spain
 - 41 phones and 40.7 TVs per 100 people.
- In an emerging economy like China (20% of the global population) the electricity network penetration is very high (about the same as in Spain) although the telephone coverage (teledensity) is quite low.
- The effect of using the electricity network for communications would be to substantially enhance the teledensity.
- <http://www.cyberschoolbus.un.org/infonation/info.asp?the me=tec&id1=156&id2=724&id3=999&id4=999&id5=999>).

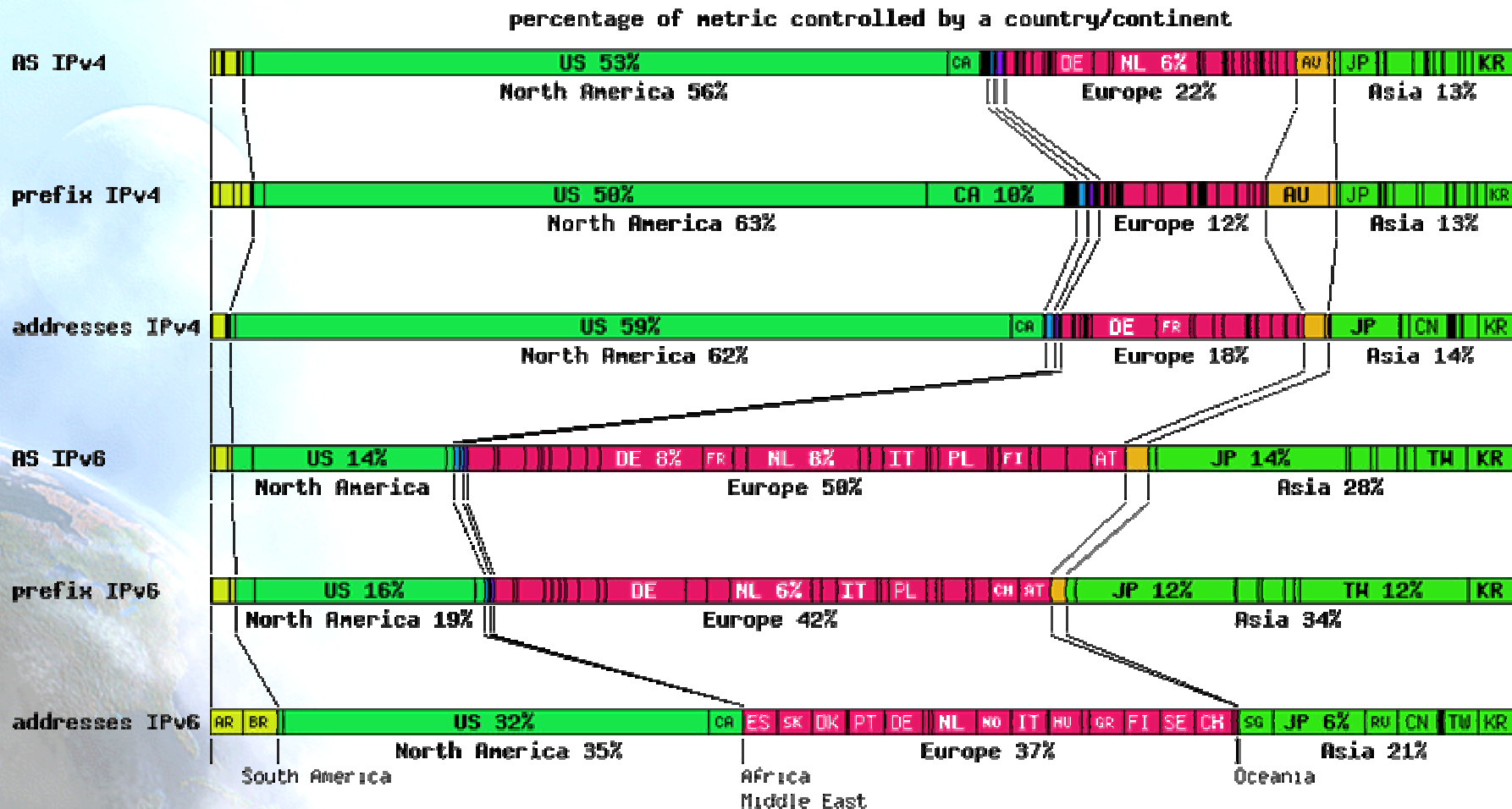
Addressing the Digital Divide?

percentage of metric controlled by a country/continent



- <http://www.caida.org/analysis/geopolitical/bgp2country/>

Addressing the Digital Divide



- <http://www.caida.org/analysis/geopolitical/bgp2country/ipv6.xml>

ISOC Paper

<http://www.isoc.org/briefings/013>



Addressing the Digital Divide with IPv6-enabled Broadband Power Line Communications

ISOC MEMBER BRIEFING #13

May 5, 2003

by Jordi Palet

Definition

Power Line Communications (PLC) allows transmission of data over power lines. PLC is potentially the network with the deepest capillarity in the world, since power lines are almost ubiquitous.

IPv6 provides a package of highly scalable enhancements to the Internet compared to the capabilities of the existing IPv4 protocol, which is today only sustained by Network Address Translation (NAT). NAT has unfortunately created unexpected barriers during the massive growth of the Internet, consequently breaking the initial end-to-end communications concept.

However, this massive IPv4 deployment happened mainly in rich countries, creating a digitally divided society. IPv6, associated with other scalable technologies like PLC, is key to redressing the balance and alleviating the digital divide, enabling more people and entire countries to access information and knowledge, which in turn will allow them to benefit from the global economy, and create new knowledge and services.

Background

New access technologies, like PLC, that have been evaluated for some years, have failed to support the legacy Internet paradigm. These technologies now have a new opportunity with IPv6, because IPv6 will give value to their deployment.

Power Line Communications has been around since the 1930's but was never seriously thought of as a medium for communication due to its low speed, low functionality and high deployment cost. However, new modulation techniques supported by recent technological advances have finally enabled this medium to become a realistic and practical means of communication.

Recently, new technology has led to integrated circuits and modems entering the market, providing high speeds over power line infrastructure at reasonable and falling cost.

Although several broadband PLC technologies have been successfully developed, there is no standard yet. Some vendors provide "low-speed" (up to 2 Mbps) data rates using single-carrier technologies (GMSK, CDMA). Some technologies are based on multicarrier modulations (OFDM) and offer higher data rates, notably a 45 Mbps OFDM PLC chipset, which is the highest data rate available at this time.

In December 2002, at least one PLC technology vendor announced that during the second half of 2003, a new generation of broadband PLC technology providing 200 Mbps of physical layer data rate would be available as a commercial product.

Technical Issues of PLC

The main advantage of PLC over other technologies is that no new cabling is required, as all the cables are already there. Every building, be it offices, apartments or houses, has the network already installed. This permits a computer,

Download the Paper

This paper available for downloading in the following formats:

- [PDF](#)
- [ASCII](#)

Expanded Coverage from ISOC

In-depth articles, papers, links and other resources on a variety of topics are available from the ISOC site at: www.isoc.org/internet/issues

Examples in the News

<http://www.ipcf.org/>
http://www.plcforum.com/docs/Italia_Oggi.pdf
http://www.plcforum.com/docs/Com_World.pdf
http://www.plcforum.com/docs/Cinco_Dias.pdf
http://www.plcforum.com/docs/PLCforum-PR_Mannheim.pdf
http://www.6power.org/noticias_6power.php
http://www.6power.org/noticias_ipv6.php
<http://the.honoluluadvertiser.com/article/2002/Nov/22/bz/bz01a.html>

Relevant IETF RFCs

Over 50 RFCs have been published by different IETF Working Groups, including those directly implicated in the standardization of IPv6, but also some others. A new WG is being formed, Zerouter, that will facilitate the large scale deployment of networks, facilitating the autoconfiguration of the devices at both, the customer end, and the ISP network itself.

From OnTheInternet

<http://www.isoc.org/oti/articles/1201/g8.html>
<http://www.isoc.org/oti/articles/1201/wilkinson.html>
<http://www.isoc.org/oti/articles/0601/rao3.html>
<http://www.isoc.org/oti/articles/0601/wang.html>

Past, Present and Future

- Look for last 24, 12 and 6 months ...
- When or Where ?
 - Geography vs. sectors vs. networks
- A prediction (40-50% traffic):
 - Asia Pacific: 2005-2006
 - Europe: 2006-2007
 - North America: 2007-2008
 - Latino America: 2006-2008
 - Rest of the World: 2006-2008
- Cost analysis vs. maintenance/operation
- Initial need of native IPv6 ?
- Old applications, using end-2-end, or new advanced apps?

Proposal: The Italian IPv6 TF Work

- Objectives:
 - Education
 - Awareness
 - Industry and associations
 - Government
 - Key web sites
 - NIC
 - IX
 - National R&D activities and funding
- National strategic plan ?
- Benchmarking the take up

Thanks !

Contact:

- Jordi Palet (IPv6 TF-SC): jordi.palet@consulintel.es
- Madrid 2004 Global IPv6 Summit, more info soon at:
<http://www.ipv6-es.com>

