Scaling the Internet for our Next Generations

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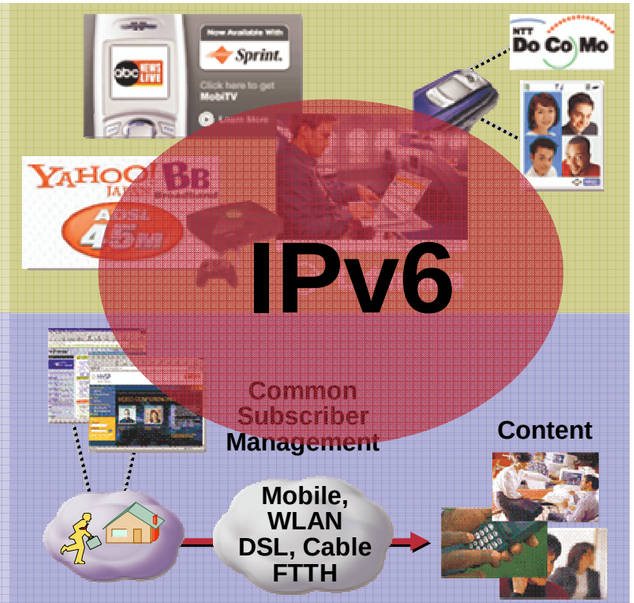
“ I truly believe that the Internet will change the way we work, live, play and learn in ways we are just beginning to explore. Our industry is maturing rapidly with the convergence of data, voice and video technology over one network. This convergence is creating a world in which technology is used to connect everyone to everything “

John Chambers, CEO, Cisco Systems

Pillars of Convergence

APPLICATION CONVERGENCE

Enabling Integration of D/V/V Services

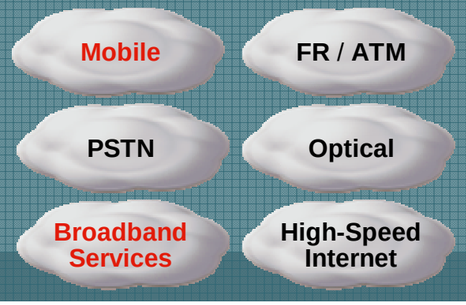


SERVICE CONVERGENCE

Service Continuity across access; Customer Loyalty

NETWORK CONVERGENCE

Eliminate Network Layers; Reduce TCO



Networking Trends

Ubiquity of the Internet

Mobility

Security and Privacy of a Network

Next Generation Networks
“*IP Agostic*”

Simplicity of Access Technologies

Bandwidth Capacity

Cisco CRS-1 – up to OC768

Content Richness of Multimedia

What is IPv6? Basic Perspectives

The Network Manager Perspective

Infrastructure focus

- Stability of a given technology, implementations and benefits
- Cost of deployment and operation

Care but…has to get confident

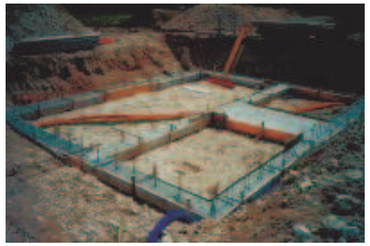
The End-User Perspective

Applications focus

- The network capability to provide the desired services
- It's all about the applications, and their services

Don't care about IPv6!!!

Building the “IPv6 House”



IESG IPng WG creation

IETF IPv6 WG Core Specs

Commercial Products & Infrastructures (6NET, GEANT,…)

More IETF specs (Mobile IPv6, DHCPv6 PD, Flow Label…), Applications port

1994

1995-1998

2001-2004

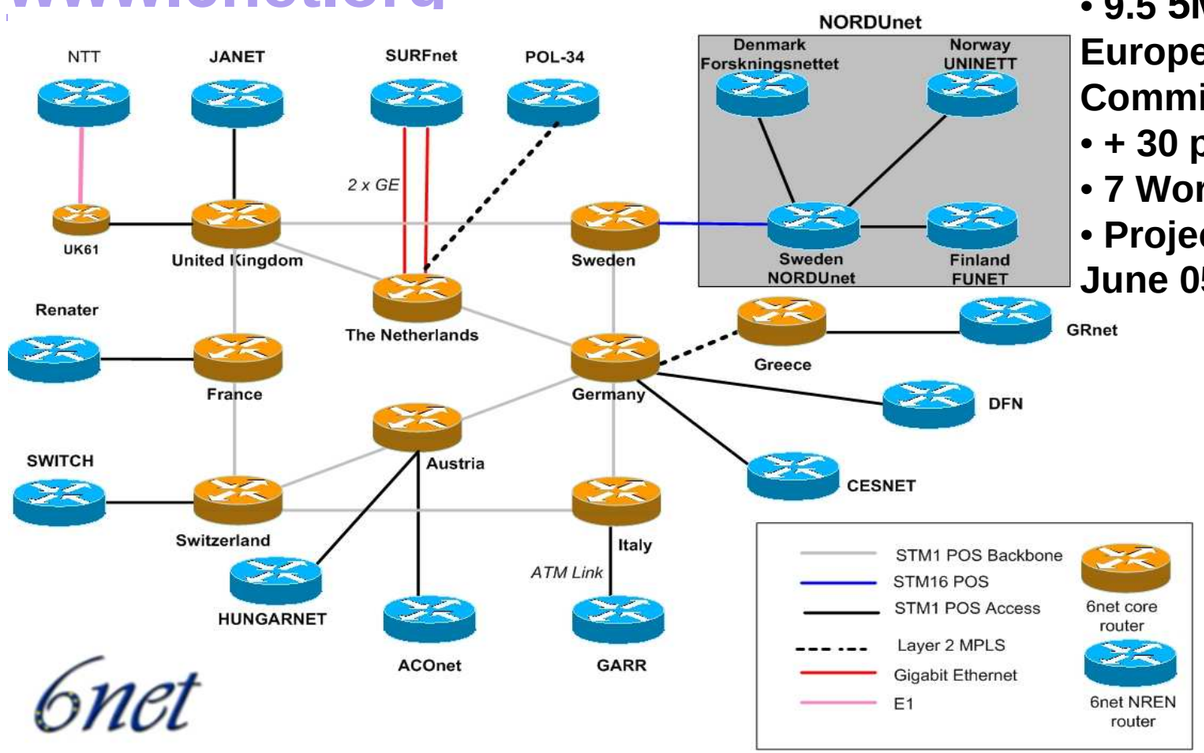
2004-2008

Today, Core IPv6 specifications are IETF Draft Standards

well-tested & stable, enabling a move to “full production”

6NET Project Overview

www.6net.org



- 3 years project
- 9.5 5M € from European Commission
- + 30 partners
- 7 Work Packages
- Project ended in June 05

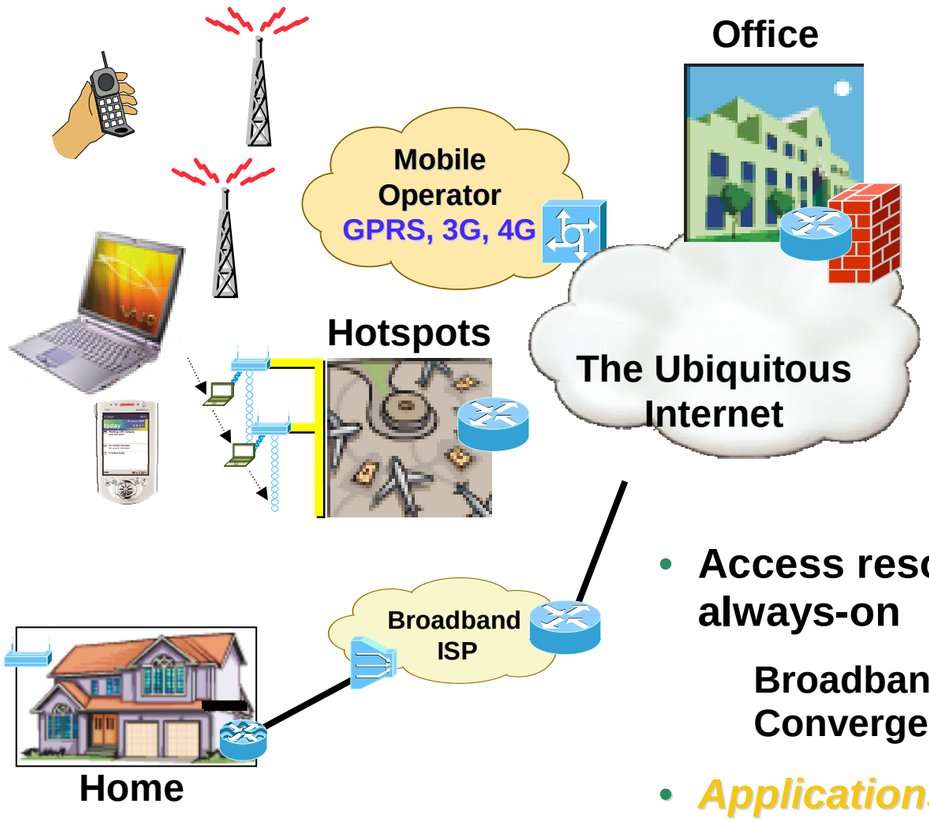
Cisco 12400 and 7200 series

Business Model – Basic Perspectives

- **Revenues from analog voice and bandwidth are decreasing on long term**
- **A need for different address allocation and charging model**
  - **IPv6 prefix (/48 to /64) versus a single dynamic or static IPv4 address**
  - **Provisioning for always-on technologies does not really allow over-subscription**
- **ISP added values/revenues need to shift to End-Points and associated services**
  - **Ie: NTT-Comms m2m-x**
  - **www.ipv6style.jp/en/apps/20040224/index.shtml**

Next Generation Broadband Home vision

IPv6 Mobility Vision



Independent from the Access Technologies

- **Unlicensed Band (WiFi,…)**
  - **Personal mobility**
  - **high data rate incremental infrastructure**
- **Licensed Band (GPRS, 3G, WiMax, DVB-T,…)**
  - **Full mobility**
  - **New infrastructure**

- **Access resources from anywhere – always-on**
  - **Broadband/Wireless services Convergence**
- ***Applications and Services have to become “Mobile”***

Traffic Evolution

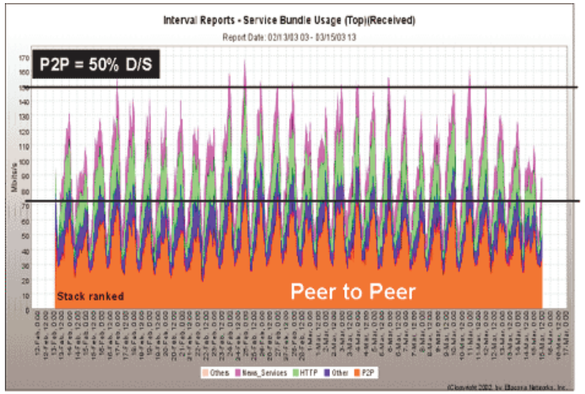
- **Applications – Server/Client, P2P, GRID – generate different traffic patterns than Client/Server**

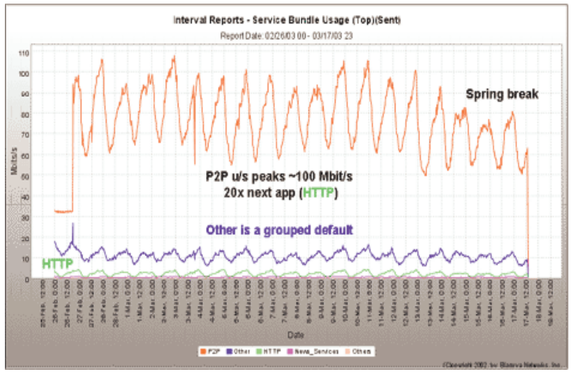
  Symmetrical – as much upstream as downstream traffic (users become servers as they deliver contents)

  Very long sessions – Always-on devices may be left unattended. Streaming applications can run for a long period of time. Often 24/7.

  Sustained high bandwidth – many devices can now use all bandwidth available. Multiple video sessions require high bandwidth capacity

  Non-local – Traffic travels globally, and between ISP networks, hence putting load on the peering points (est. 60% of traffic) and expensive long haul links.





Some Technical Challenges – Opportunities

- **IPv6 Core specifications are stable and implemented**
- **Multi-Homing**

  From IETF Multi6 WG charter

  The multihoming approaches currently used in IPv4 can of course be used in IPv6, but IPv6 represents an opportunity for more scalable approaches.

- **Security**

  Though IPsec is mandatory in IPv6, Security is a much broader topic than just IPsec as same issues remain from IPv4:

  Configuration complexity, Key management…

  Centralized (Firewall) – Distributed (IPsec on hosts) co-existence

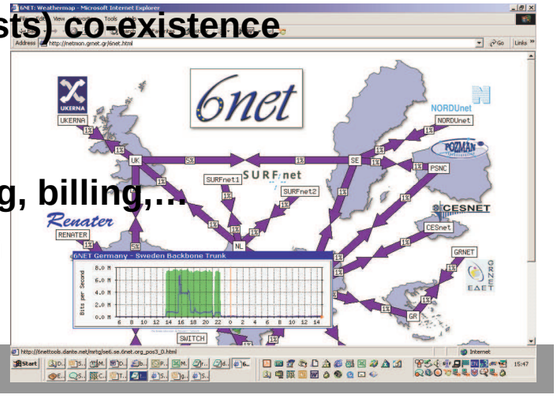
- **Dual Stack Network Management**

  MIB's dependencies – RFC 3796

  Net Mgnt Applications – provisioning, monitoring, billing,…

  Renumbering on large scale Internet population

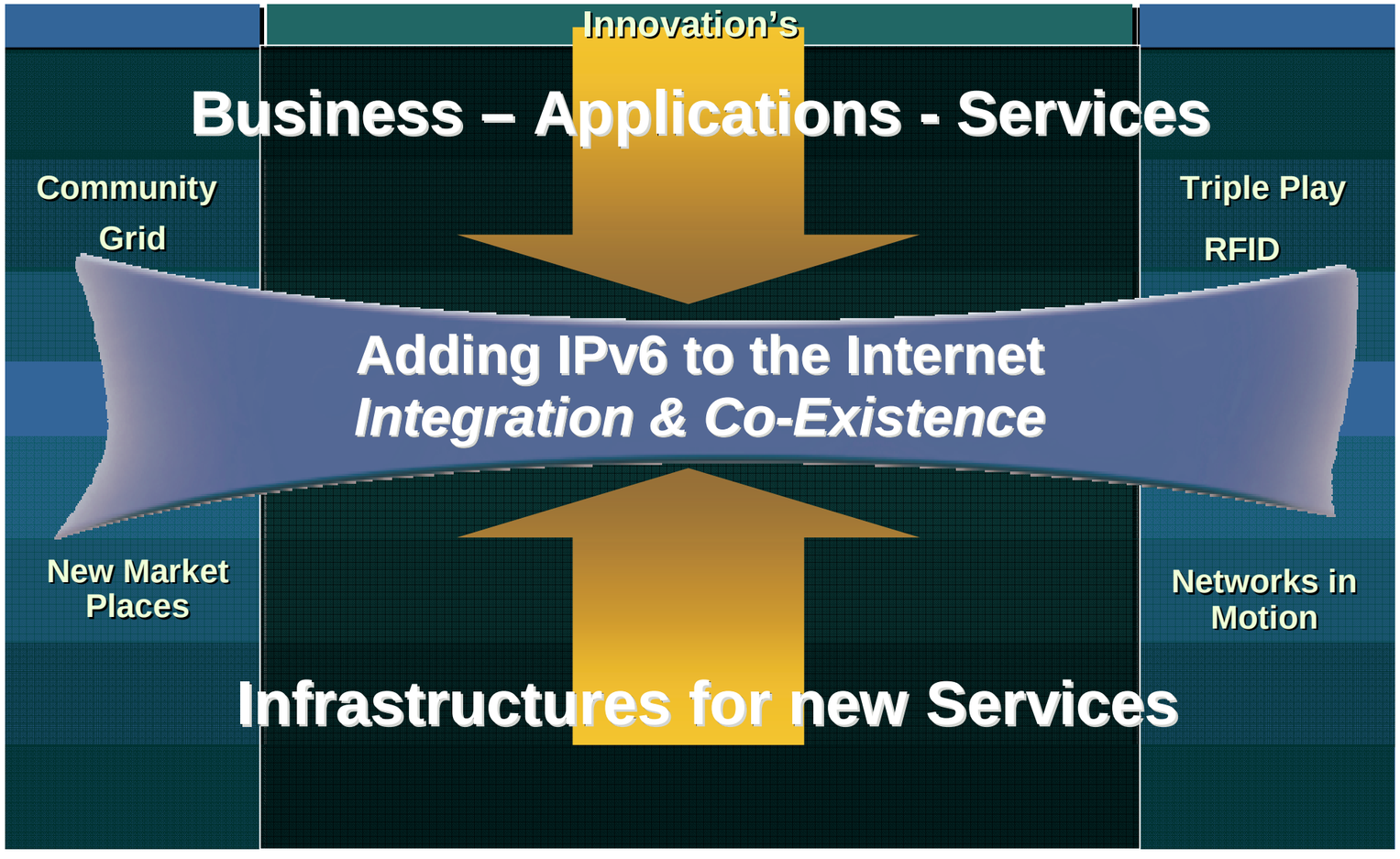
An opportunity for Research



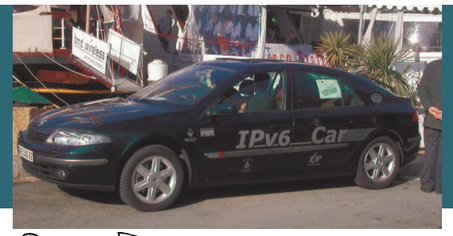
Some non-Technical Challenges

- **The Internet is “highly decentralized” – Regional modes of adoption**
  - **IPv6 impacts the overall infrastructure**
    - **Status Quo (no change) versus Co-Existence (Niche) versus Full Integration**
- **Education**
  - **Next generation’s graduates are key for IPv6 deployment**
  - **IPv6 knowledge represents job’s opportunity for tomorrow (ie: Cisco Network Academy)**
- **Social impacts of the Internet environment**
  - **Privacy, Usage,…**
- **Intellectual Property Rights (IPR)**
  - **Not related to IPv6 but may be highlighted by usage**

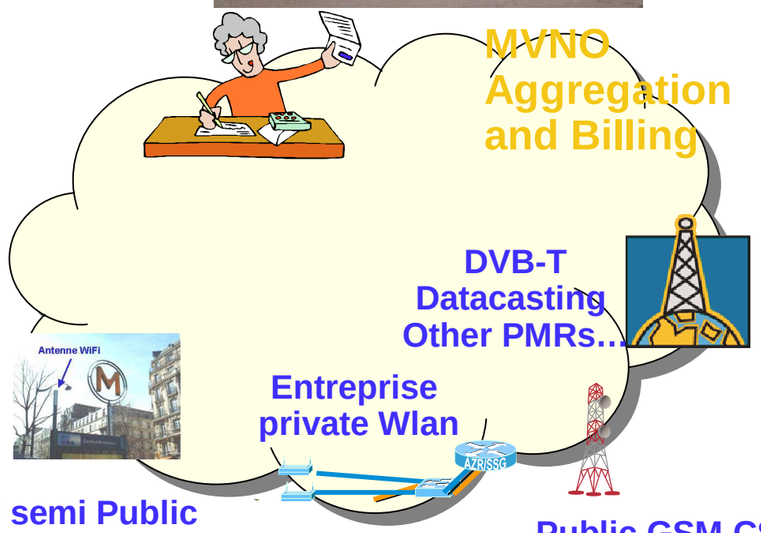
Expanding the Internet with IPv6

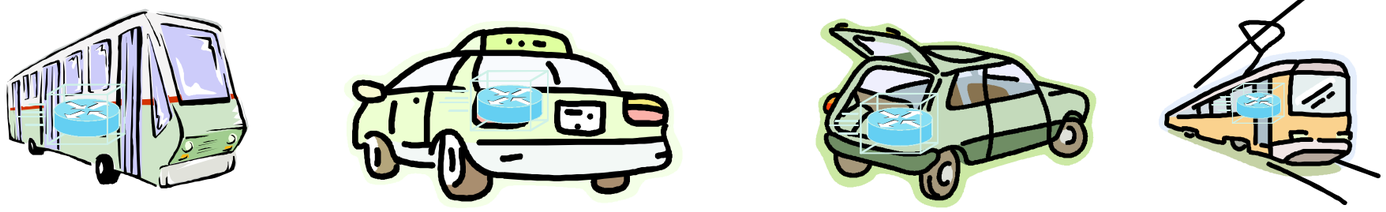


Networks in Motion

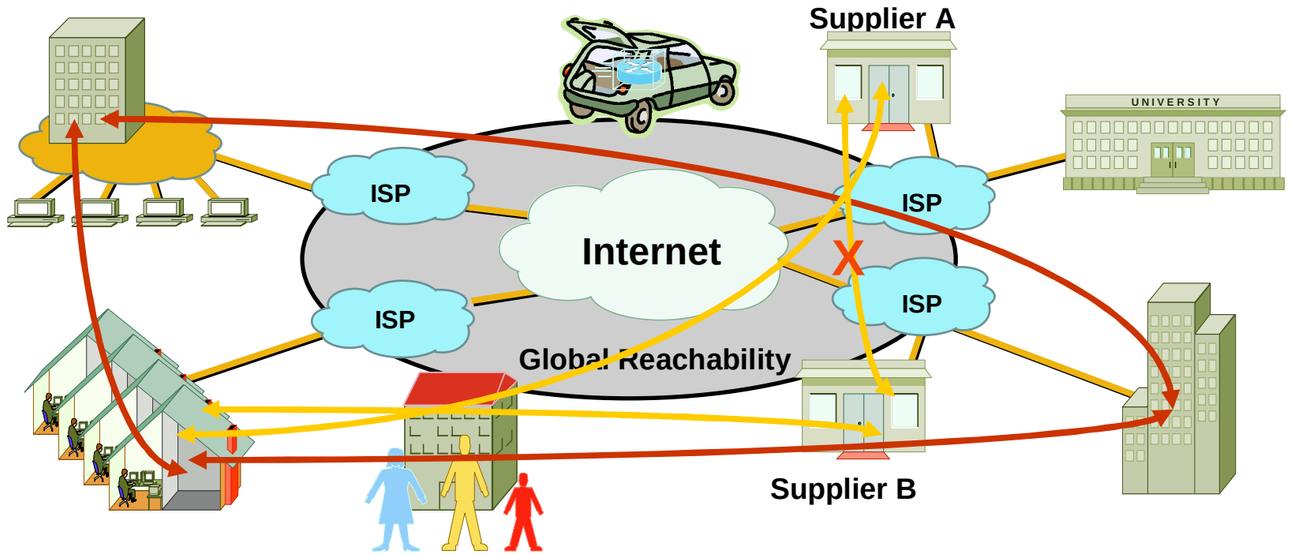


Pure M2M	2 ways apps wit UI	Hot Spots in vehicles
Safety Vehicles	Public Transport	Profes. Fleets
MVNO – Authentication, Mobile IP, Billing		
GSM, UMTS, EDGE, public coverage	WLANs, DVB-T, PMR	Satellites





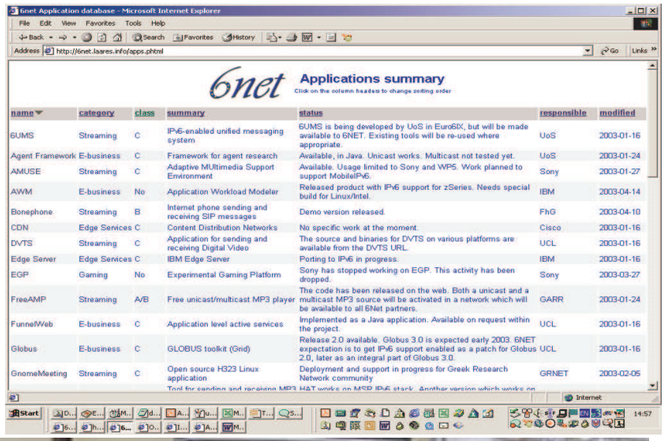
Community of Interest Overview



- **IPv6 global addressing does NOT necessarily means Universal Reachability for all devices**
- **IPv6 Community of Interest should enable Customers/suppliers, families/friends or communities of interest to share the network infrastructure to dedicate their devices/apps access**
  - **Plug & Play and Secure**
  - **Intuitive to deploy and use for mass-market**

IPv6 Integration – Per Application Model

Today, all O.S. are Dual-Stack



- **As soon as the infrastructure is IPv6 capable…IPv6 integration can follow a non-disruptive "per application" model**

New Generation of Internet Appliances

A Case Study – IP in Schools Today

- **School's business is Education**
  - **Read, Write, Maths, Foreign Languages as foundations to Knowledge**
    - **The above are minimum end-users requirements to access the Internet**
  - **Analytic mind is key to value the data retrieved from the Internet**
- **Schools are part of the Information Society**
  - **Today, more and more schools get an Internet connection – a Must**
    - **Lease lines, Broadband Access,…**
    - **Linked to NRN or local government**
- **Today, Applications and Services**
  - **Client-Server: e-mails, web browsing**
  - **Servers generally hosted externally**
    - **Most of the time using PAT (a single global IPv4 address)**

A Case Study – IPv6 in Schools Tomorrow

- **Developing new Class of Applications and Services**
  - **Class to Class collaboration – internal to the school, between schools (national & international)**
    - **Sharing Database, creating server's,…**
  - **Teachers-Students collaboration**
    - **"After-time" support, digital pupil desk, foreign languages class,…**
  - **Content delivery between schools or Information Providers – Multimedia streaming**
  - **IP Telephony between schools**
  - **Tele-surveillance – Physical security**
  - **Secure Information – Transfer between schools-academy, teachers-school**
- **Integrating those services over IPv6**
  - **IPv6 could easily be configured on (Cisco☺) routers connecting the schools**
  - **NRN or Local Government can delegate production IPv6 prefixes to the schools.**
- **It must be done Today**
  - **IPv4 applications do not get disturbed**
  - **Keep IPv4 as it is, even using PAT**



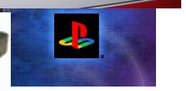
IPv6 - Key driver for next generation ubiquitous networking

Business

Innovations

Mobility

Consumer
& Services



Services

The Ubiquitous Internet

Agriculture/Wildlife

Medical

Transportation

Manufacturing

Higher Ed./Research

Government
Public Sector

Cisco Systems – Leading the Evolution

- Cisco IOS based networks are IPv6-enabled since 2001
- Cisco IPv6 Solutions now include Routers, Layer 3 switches, Firewall, Network Management,…
- Cisco and IETF standardization
  - Co-chairs IETF IPv6, NG Trans WG co-chair for several years
  - Today, co-chair v6Ops, DHCPv6, MIPv6 WG
  - Author/co-authors many IETF proposals
    - MP-BGP4, NAT-PT, 6PE/6VPE, DHCPv6 PD,…
- Founding member of the IPv6 Forum
- Partnership on large scale IPv6 deployment/trials
  - 6Net, Moonv6,…
- Mobile Networking– IPv6 Promotion council “Jun Murai award”

Q and A

More Information

- **CCO IPv6 -** http://www.cisco.com/ipv6
- **Cisco IPv6 Solutions**

  http://www.cisco.com/en/US/tech/tk872/technologies_white_paper09186a00802219bc.shtml
- **The ABC of IPv6**

  http://www.cisco.com/en/US/products/sw/iosswrel/ios_abcs_ios_the_abcs_ip_version_6_listing.html
- **IPv6 Application Notes**

  http://www.cisco.com/warp/public/732/Tech/ipv6/ipv6_techdoc.shtml
- **Cisco IOS IPv6 manuals**

  http://www.cisco.com/univercd/cc/td/doc/product/software/ios123/123cgcr/ipv6_vcg.htm