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

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<th>Application Convergence</th>
<th>Enabling Integration of D/V/V Services</th>
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<td>Service Continuity across access; Customer Loyalty</td>
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<td>Network Convergence</td>
<td>Eliminate Network Layers; Reduce TCO</td>
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**IPv6**

**Common Subscriber Management**
- Mobile, WLAN
- DSL, Cable FTTH

**Content**
- Mobile
- FR / ATM
- PSTN
- Optical
- Broadband Services
- High-Speed Internet

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Networking Trends

Ubiquity of the Internet

Mobility

Security and Privacy of a Network

Simplicity of Access Technologies

Next Generation Networks “IP Agnostic”

Bandwidth Capacity
Cisco CRS-1 – up to OC768

Content Richness of Multimedia

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
1994

IETF IPv6 WG Core Specs
1995-1998

Commercial Products & Infrastructures (6NET, GEANT,…)
2001-2004

More IETF specs (Mobile IPv6, DHCPv6 PD, Flow Label…), Applications port
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
• 9.5M € from European Commission
• + 30 partners
• 7 Work Packages

Cisco 12400 and 7200 series

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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
Next Generation Broadband Home vision

Home Networking
- IPv6 enables bi-directional reachability for multiple devices, is not intended to a single PC
- Bandwidth increase and symmetric access to generate contents
- Easy plug and play

Wireless Laptop
- Distance learning
- Video calls
- MP3/MP4 downloads

IP Video

Printer

IP Phone & Fax

Wireless Laptop

PDA

Wired Devices
- Streaming Video/Audio
- Print/file sharing

Broadband Internet Access

Triple Play Services
- Multiple devices served in a Home
- Commercial download
- TV guide

Broadband Access Point
- Multiplayer gaming
- Video on demand
- Home security
- Digital audio
- Domestic appliances

IP Video

Broadband Internet Access

Wireless Gaming

Home Networking

Wired Devices

Print/file sharing

Wireless Gaming
IPv6 Mobility Vision

- **Access resources from anywhere – always-on**

- **Applications and Services have to become “Mobile”**

  - **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

- **Convergence**

  Broadband/Wireless services
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 Mgmt 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

Adding IPv6 to the Internet

Integration & Co-Existence

Innovation’s

Business – Applications - Services

Community Grid

New Market Places

Infrastructures for new Services

Triple Play

RFID

Networks in Motion

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Networks in Motion
Telematics: Industry related to using computers in concert with telecommunications systems. This includes Internet access, as well as all types of networks that rely on a telecommunications system to transport data.

“Telematics to Become $8 Billion Industry by 2005, According to New Study from Allied Business Intelligence”

http://www.telematicsupdate.com
Community of Interest Overview

- IPv6 global addressing does NOT necessarily mean 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

• As soon as the infrastructure is IPv6 capable...IPv6 integration can follow a non-disruptive “per application” model

Today, all O.S. are Dual-Stack

Call for Applications – protocol agnostic peer-to-peer versus client-server transaction

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
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”
More Information

- CCO IPv6 - [http://www.cisco.com/ipv6](http://www.cisco.com/ipv6)
- Cisco IPv6 Solutions
- The ABC of IPv6
- IPv6 Application Notes
- Cisco IOS IPv6 manuals