Scaling the Internet for our Next Generations

Patrick Grossetete
Cisco Systems
Manager, Product Management
pgrosset@cisco.com
“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

- Broadband Services
- PSTN
- Optical
- High-Speed Internet
- FR/ATM
- Mobile
- Mobile, WLAN, DSL, Cable FTTH
- Common Subscriber Management
- Content
- IPv6
Networking Trends

Ubiquity of the Internet

Simplicity of Access Technologies

Next Generation Networks “IP Agnostic”

Mobility

Security and Privacy of a Network

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””

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
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

- 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 content
- Easy plug and play

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

**IP Phone & Fax**
- Distance learning
- Video calls
- MP3/MP4 downloads

**PDA**
- Distance learning
- Video calls
- MP3/MP4 downloads

**IP Video**
- Distance learning
- Video calls
- MP3/MP4 downloads

**Printer**
- Distance learning
- Video calls
- MP3/MP4 downloads

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

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

**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
IPv6 Mobility Vision

- **Access resources from anywhere – always-on**
  - Broadband/Wireless services
  - Convergence
- **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
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

Business – Applications - Services

Innovation’s

Infrastructures for new Services

Community Grid

New Market Places

Networks in Motion

Triple Play RFID

New Market Places
## Networks in Motion

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<td><strong>MVNO – Authentication, Mobile IP, Billing</strong></td>
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<td>GSM, UMTS, EDGE, public coverage</td>
<td>WLANs, DVB-T, PMR</td>
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### Services
- MVNO Aggregation and Billing
- DVB-T Datacasting
- Other PMRs...
- Entreprise private Wlan
- Public and semi Public WLAN services
- Public GSM CSD GPRS, UMTS, EDGE
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

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

The Ubiquitous Internet

- Business
- Innovations
- Mobility
- Consumer & Services
- Services
- Higher Ed./Research
- Agriculture/Wildlife
- Medical
- Transportation
- Government Public Sector
- 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-BGP, 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](http://www.cisco.com/ipv6)
- Cisco IPv6 Solutions
- The ABC of IPv6
- IPv6 Application Notes
- Cisco IOS IPv6 manuals