IPv6 Prospects
TERENA – Rhodes – June 9th, 2004

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Agenda

• Building the “IPv6 House”
• IPv6 Prospects
  Innovation and new Business Models
What is IPv6? Basic Perspectives

The End-User Perspective
• 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”
Networking Trends

- Mobility through a Wireless Network
- Ubiquity of the Internet
- Security and Privacy of a Network
- Simplicity of Ethernet
- Capacity of an Optical Network
- IPv6 Ready
- Content Richness of Television

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Broadband Home – A necessity for IPv6!

**Home Networking**
- At the heart of the digital home sits the Broadband access point distributing a host of enhanced content and services throughout the home.

**Wired PC**
- Streaming Video
- Print/file sharing

**Broadband Internet Access**
- Internet access
- Multiple voice lines
- Wireless printing
- Wireless IP Phone

**Wired PC**
- Streaming Video
- Print/file sharing

**IP Phone**
- Distance learning
- Video calls
- MP3 downloads

**Tivo Services**
- Commercial download
- TV guide

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

**Home Networking**
- Internet access
- Multiple voice lines
- Wireless printing
- Wireless IP Phone
Mobile Wireless Networking – an IPv6 Must

WiFi HotSpots

Mobile Operator
GPRS, 3G, 4G

Enterprise’s
• Unlicensed Band (WiFi,…)
  Personal mobility
  high data rate
  incremental infrastructure

• Licensed Band (GPRS, 3G,…)
  Full mobility
  Modest data rate
  New infrastructure

The Ubiquitous Internet

Mobile Wireless Networking challenges

• Manage the growth of subscribers
  CY04, 1.5B Mobile Phone’s users

• Address this large number of “Always-reachable” devices

• Support a Multimedia environment

The IPv6 Benefits

WiFi at Home

Broadband ISP
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

Call for Applications – protocol agnostic

New Generation of Internet Appliances
Some non-Technical Challenges

• The Internet is “highly decentralized” – Regional modes of adoption
  IPv6 impacts the overall infrastructure
  Must avoid an Internet balkanization
  Status Quo (no change) versus Co-Existence (Niche) versus Full Integration

• Education
  Next generation’s graduates are key for IPv6 deployment

• Social impacts of this new Internet environment
  Privacy, Usage,…

• Intellectual Property Rights (IPR)
  Not related to IPv6 but may be highlighted by usage
Agenda

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  Innovation and new Business Models
Business Model – Basic Perspectives

• 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 need to shift to End-Points and associated services
  Ie: NTT-Comms m2m-x
Traffic Evolution

- Applications – Server/Client, P2P, GRID – generate different traffic patterns than Client/Server
  - Symmetrical – as much upstream as downstream traffic (users become servers)
  - 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

• 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
  
  Network Management Applications – provisioning, monitoring, billing,…
  
  Plug & Play/Re-numbering on large scale Internet population

*An opportunity for Research*
IPv6 Enables New Eco-Systems

Supplier’s

Telephony
• Wireless (Wi-Fi, GSM, GPRS)
• Inexpensive (VoIP)

Gaming
• Online
• Network

Video
• Subscription
• On Demand

Music
• Subscription
• Per Download

Utilities
• Monitoring
• Reporting

Broadband Gateway
• Simple Install
• Intuitive to Use
• Pay Per Service
• Remote Troubleshoot

NAS Storage
• Music
• Movies
• Games
• Documents

Data
• Always On
• Secure

Parental Controls
• Across all Clients
• Web, Email, Chat, Time
• Multiple Access Levels

Home Monitoring & Security
• Motion
• Remote

The Fridge’s Case Study

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Expanding the Market Place
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
A need for IPv6 Ez-CUG

- IPv6 global addressing does not necessarily mean Universal Reachability for all devices
- IPv6 Easy Closed User Groups 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
A Case Study – IPv6 in Schools (1)

- 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 (2)

• 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 can be done Today
  IPv4 applications must not get disturbed
  Keep IPv4 as it is, even using PAT
School’s Case Study – configuration

Cisco IOS Routers
- Cisco 830 series IOS 12.3(4)XG
- Cisco 1700 series IOS 12.3(7)T

Potential IPv6 Services
- Multicast
- Firewall
- QoS

IPv6 reachable prefixes
- 2002::/16, 2001::/16 & 3FFE::/16

Note: IPv6 configuration only

```
router# conf term
router#(config)ipv6 unicast-routing
router#(config)ipv6 cef
router#(config)interface ethernet0
router#(config-if) ipv6 address 2001:420:2301:1::/64 eui-64
router#(config) interface serial0
router#(config-if) ipv6 address 2001:420:2301:2::/64 eui-64
router#(config) ipv6 route ::/0 interface serial0
```
IPv6 – A Key Driver for the e-Economy

O.S. & Applications

Mobile Networking

The Ubiquitous Internet

Restoring an environment for Innovation

Services on the edge of the Network

Consumer & Services

Transportation

Agriculture/Wildlife

Medical

Higher Ed./Research

Government (Federal/Public Sector)
Cisco Systems

Empowering the Internet Generation
More Information

- The ABC of IPv6
- IPv6 Application Notes
- Cisco IOS IPv6 manuals
# Internet around the world

http://www.nav6tf.org/RIR_eNations/RIR_eNations.html

<table>
<thead>
<tr>
<th>Nation (Internet code)</th>
<th>Population (2003)</th>
<th>Internet users (2002)</th>
<th>Internet Penetration Rate</th>
<th>Global IPv4 address assigned per country</th>
<th>Current /8 equivalent</th>
<th>addresses needed to reach 20% H-ratio of 85%</th>
<th>Number of IPv4 /8 required for 20% H-ratio of 85%</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Worldwide</strong></td>
<td>6,321,688,311</td>
<td>613,040,319</td>
<td>9.70%</td>
<td>2,455,834,135</td>
<td>147</td>
<td>6,229,490,19</td>
<td>7</td>
</tr>
<tr>
<td><strong>(IANA)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>372.3</td>
</tr>
<tr>
<td>China (.cn)</td>
<td>1,304,196,000</td>
<td>56,600,000</td>
<td>4.34%</td>
<td>44,007,936</td>
<td>2.630</td>
<td></td>
<td>105.00</td>
</tr>
<tr>
<td>India (.in)</td>
<td>1,065,462,000</td>
<td>7,000,000</td>
<td>0.66%</td>
<td>2,804,480</td>
<td>0.170</td>
<td></td>
<td>101.28</td>
</tr>
<tr>
<td>Indonesia (.id)</td>
<td>219,883,000</td>
<td>4,400,000</td>
<td>2.00%</td>
<td>1,141,504</td>
<td>0.070</td>
<td></td>
<td>15.58</td>
</tr>
<tr>
<td>Brazil (.br)</td>
<td>178,470,000</td>
<td>13,980,000</td>
<td>7.83%</td>
<td>1,199,160</td>
<td>0.080</td>
<td></td>
<td>12.08</td>
</tr>
<tr>
<td>Pakistan (.pk)</td>
<td>153,578,000</td>
<td>1,200,000</td>
<td>0.78%</td>
<td>254,464</td>
<td>0.020</td>
<td></td>
<td>10.44</td>
</tr>
<tr>
<td>Bangladesh (.bd)</td>
<td>146,736,000</td>
<td>150,000</td>
<td>0.10%</td>
<td>128,000</td>
<td>0.010</td>
<td></td>
<td>9.94</td>
</tr>
<tr>
<td>Nigeria (.ng)</td>
<td>124,009,000</td>
<td>100,000</td>
<td>0.08%</td>
<td>114,688</td>
<td>0.010</td>
<td></td>
<td>8.15</td>
</tr>
<tr>
<td>Russia (.ru)</td>
<td>143,246,000</td>
<td>18,000,000</td>
<td>12.57%</td>
<td>7,638,944</td>
<td>0.460</td>
<td></td>
<td>6.74</td>
</tr>
<tr>
<td>Vietnam (.vn)</td>
<td>81,377,000</td>
<td>400,000</td>
<td>0.49%</td>
<td>159,232</td>
<td>0.010</td>
<td></td>
<td>4.94</td>
</tr>
<tr>
<td>Philippines (.ph)</td>
<td>79,999,000</td>
<td>4,500,000</td>
<td>5.63%</td>
<td>765,696</td>
<td>0.050</td>
<td></td>
<td>4.62</td>
</tr>
<tr>
<td>Mexico (.mx)</td>
<td>103,457,000</td>
<td>3,500,000</td>
<td>3.38%</td>
<td>6,311,936</td>
<td>0.380</td>
<td></td>
<td>4.32</td>
</tr>
<tr>
<td>Ethiopia (.et)</td>
<td>70,678,000</td>
<td>20,000</td>
<td>0.03%</td>
<td>16,384</td>
<td>0.010</td>
<td></td>
<td>4.23</td>
</tr>
<tr>
<td>Egypt (.eg)</td>
<td>71,931,000</td>
<td>600,000</td>
<td>0.83%</td>
<td>853,504</td>
<td>0.060</td>
<td></td>
<td>4.02</td>
</tr>
<tr>
<td>Iran (.ir)</td>
<td>68,920,000</td>
<td>420,000</td>
<td>0.61%</td>
<td>581,888</td>
<td>0.040</td>
<td></td>
<td>3.91</td>
</tr>
<tr>
<td>Turkey (.tr)</td>
<td>71,325,000</td>
<td>2,500,000</td>
<td>3.51%</td>
<td>2,429,696</td>
<td>0.150</td>
<td></td>
<td>3.44</td>
</tr>
</tbody>
</table>

The table shows the population, internet users, and penetration rates for various countries, along with the number of IPv4 addresses assigned and the number of IPv4 /8 required to reach a 20% H-ratio of 85%.