IPv6 Deployment

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Session Objectives

- Why IPv6? – Very Brief

- Where we're at with IPv6 – Current Landscape

- IPv6 Deployment – Majority Focus

Q&A throughout, I may postpone questions until the end depending on time

Why IPv6?

- Address space
  - Facilitates communication/collaboration
  - Should be a virtually unlimited supply – think street addresses
- Innovation
  - NAT Gateways make innovation harder (mainly driven by insufficient address space)
  - Productivity (easy communication/collaboration) is a key business objective which NAT impedes

Roadmap

- Why IPv6?
- **Where we're at with IPv6**
- IPv6 Deployment

In the Near Future...

IPv6 Technology Adoption

Innovators (1998-2010)   Early Adopters (2011-13)

Early Majority (2014)   Late Majority (2015)

Laggards (2016)   IPv6 Only Internet (2020)

IPv6 Actual Usage

- Global IPv6 traffic for Google ~ .7%
- US IPv6 traffic for Google ~ 1.42%

Tier 1 ISP IPv6 Deployment

Deployed and in sales mode

- AT&T

- Verizon Business (UUNET)

- Level 3

- Sprint

- Centurylink (Qwest/Savvis)

- XO Communications

- Inteliquent (Tenet)

Cellular/Mobile Deployment

Over 5.3 billion devices and growing

- Verizon Wireless - IPv6 required on LTE/4G
- AT&T Mobility - In progress, but no dates
- Sprint Nextel - Deploying this year
- T-Mobile - IPv6 fully deployed for 4G
- 2012 – SmartPhone sales to exceed PC sales (Morgan Stanley Research)

Cellular/Mobile Deployment

Interesting Challenges Posed by IPv6 and 4G

- IPv6 goes hand in hand with LTE/4G

- Android 4.0 supports IPv6 cellular connectivity today (Samsung Galaxy models)

- Apple iOS 6.0 (this fall) supports IPv6 for cellular connections

- Enterprise BYOD/SmartPhone/Tablet 4G Strategy?

Residential ISPs - Cable

IPv6 Deployment Status, Over 1 Million Subscribers

- Comcast - Deploying since 2011
- Time Warner - Deploying
- Cox - Deploying in 2013
- Charter - Deploying
- Cablevision - ?

Residential ISPs - DSL

IPv6 Deployment Status, Over 1 Million Subscribers

- AT&T - Deploying since 2011

- Verizon - Deploying in Q3 2012

- CenturyLink (Qwest/Savvis) - Deploying

- Frontier - ?

- Windstream - ?

Content Providers with IPv6

- Akamai – Delivers 15-30% of all web traffic
- Of Top 10 US Sites, 5 have IPv6 enabled:

  1) Google   2) Facebook

  3) YouTube   4) Yahoo

  6) Wikipedia

- Netflix – 32.7% of Internet bandwidth
- 10% of top 1000 sites including Bing, AOL, XBOX, WebEx, US News, USDA, NYU, …

IPv4 Address Markets

- Price per IPv4 address from $8-13/address
- 88 address block transfers recorded by ARIN as or March this year (/12 to /16)
- ARIN to APNIC transfers allowed
- Many law firms and companies entering the IPv4 address "sales and leasing" business
- Interesting area to watch

What about CGN?

- Breaks/Causes Erratic Behavior with Video Streaming, Peer-to-Peer, On line gaming, FTP

- Degrades user experience

- Is expensive to deploy and support
  - Logging for regulatory compliance
  - Hurts advertising/geo-location
  - Major security implications
  - Greatly complicates troubleshooting
  - Is more expensive to deploy than IPv6

Time Warner Cable Study Conclusions for CGN

- CGN costs $40/user per year

- Per IPv4 address cost & ISP business model:

$0 - $40 Buy Addresses	$40 - $71 Deploy CGN	$70 + CGN + Sell IPv4

- ARIN depletion (mid 2013) impact on ISP usage fees and IPv6 deployment
  - CGN access, current price + 13% rate hike
  - Public IPv4 address, current price + 21%
  - Universal IPv6 deployment will occur in/by the end of 2014

Your Users and Customers

- 1 in 100 of your users and customers now surf via IPv6

- IPv6 Business Options
  - A. Start a pilot program
  - B. Ignore them – it's only 1%

- What do other business units in your company think about your decision?
  - Sales, Marketing, Human Resources

Thoughts on IPv6 Adoption

"You can either do a planned, careful migration, or you can do it in a panic. And you should know full well that panicking is more expensive."

--Martin Levy, Hurricane Electric

Panic Driven Deployments

An ISP is actually quite busy rolling out IPv6 after their CFO got a call from a stock analyst right during the RIR meeting, asking questions "so what are your IPv6 plans?" – "none, what is IPv6?" – "oh, this is not so good"... full panic down the management chain...

Right now Enterprises have a little time – don't wait too long.

Roadmap

- Why IPv6?
- Where we're at with IPv6
- **IPv6 Deployment**

Build Your Team

IPv6 is a systemic change, in addition to the network team you'll need:

- Systems/System Administration
- Development/Applications/DBAs
- Security
- Desktop
- Operations – Monitoring/Tools, Help Desk
- Management Support

Assess Your Infrastructure

- Network/Security Equipment
  - IPv6 done in hardware/line rate?
  - IPv6 done in software (degraded performance)?
  - Upgrade(s) required?
  - Roadmapped support but not current?
  - Incompatible?

Assess Your Infrastructure

- Operating Systems
  - Which versions fully support IPv6?
    - Windows Vista, 7, 8, Server 2008, Server 2012
    - OS X 10.7+
    - Fedora 17, Ubuntu 12.04
    - UNIX, FreeBSD 9.0
  - Which versions have issues/limitations?
    - Windows XP, Server 2000, Server 2003
    - OS X before 10.7
    - Some quirks with older versions of Linux

Assess Your Infrastructure

- Applications
  - Web Servers and supporting software
  - E-mail
  - Databases
  - Network Management Systems
  - COTS and custom applications

Build Your Lab

- IPv6 Only Network (only way to eliminate IPv4 crutch)

- Front Ended Network (load balancer/ADC, forward/reverse proxy server)

- Tunneled Network (ISATAP, 6to4, 6rd, Teredo, TSP/AYIYA)

- NAT (NAT66, NAT64, NAT46, NPTv6)

- Representative hardware/software

Build Business Support

IPv6 Business Case

- Business Continuity for Internet Access
- Specific Use Cases
  - Internet of Things (Gartner – A top 10 strategic technology in 2012)
  - Industry specific (SmartGrid, Embedded Networks, Building controls/sensors, etc.)
- BYOD/Mobility around 4G

Building Your Project Plan

- Secure management commitment
- Incremental, measurable, and achievable steps
- Be realistic, start simple – IPv6 Multicast Routing may not be required on day 1
- Effective risk analysis and containment
- Managing/motivating non-compliant vendors and teams

Project Time Lines

- For most Enterprises, IPv6 is a multi-year project

- The overall infrastructure needs to be split up into phases

- Phases must be prioritized against goals and top business cases

Training

What is your development plan for:

- Network staff

- Systems staff

- Developers

- DBAs

- Security staff

- Desktop staff

- Operations – Monitoring/Tools, Help Desk

Deployment Approaches

- Start with Pilot

Decide on roll out:

- Core out (easiest but slowest)

- Edge in (provide IPv6 access from inside)

- Internet Edge (business continuity)

IPv6 Address Planning

- Probably the most important part of your deployment!

- PI or PA?

- Smallest advertised prefixes which won't be filtered (BGP, PI, PA)

- ULAs?

- IPAM?

IPv6 Address Planning

- Start with a /48 per site
- Allocate by nibble
- Learning to think in /64s
- Router point-to-point networks
- Loopbacks

IPv6 Mindset Changes

- Learning to think in networks instead of hosts

- Letting go of the address scarcity mentality

- Effective use of IPAM tools become crucial

- Running a multiprotocol network – back to the IPX/AppleTalk/DECNet days

IPv6 Enablement

- Dual Stack – Preferred where possible (hardware/software support)
- Front ending (Internet only) – Use load balancers and/or reverse proxies
- Tunnels (e.g. ISATAP) – No hardware support or IPv6 islands
- NAT – Last resort, can be complex

Operational Issues/Risks

- Rogue RAs (Windows Internet Connection Sharing)

- Rogue Tunnels

- Overlay containment when tunneling (ISATAP reach/control)

- DNS Issues

- Broken IPv6 and Happy Eyeballs