IPv6: A Pragmatic View

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Preface

Pol•ly•an•na |ˌpälēˈanə|

noun
an excessively cheerful or optimistic person.

DERIVATIVES

Pollyannaish |-i sh | |ˌpɑliˈønɪʃ| adjective
Pollyannaism |-ˌizəm| |ˌpɑliˈønəˈɪzəm| noun

ORIGIN early 20th cent.: the name of the optimistic heroine created by Eleanor Hodgman Porter (1868–1920), American author of children's stories.

Future of the Internet

The Good, the Bad, and the Ugly

- A transition approaches
  - In the extreme, there are 3 options:
    - The "Bad"
      - Internet growth stops
    - The "Ugly"
      - Layers upon layers of Network Address Translation (NAT)
    - The "Good"
      - IPv6

- "Choose Wisely"

What is IPv6?

- "Internet Protocol Next Generation"
- Core standards finalized by the IETF in 1996
  - Based on "Simple Internet Protocol Plus"
    - Essentially IPv4 with MUCH bigger addresses and simplified header structure
- 340,282,366,920,938,463,463,374,607,431,768,211,456
  - Total number of addresses in IPv6
- 18,446,744,073,709,551,616 (64 bits)
  - "LAN segment" addresses and number of LANs
- 281,474,976,710,656 (48 bits)
  - Number of independent networks

IPv6 vs. IPv4

- IPv6 purported to have (over IPv4):
  - ~~Built-in security~~
  - ~~Higher performance~~
  - ~~Better support for Quality Of Service (QOS)~~
  - ~~Built-in Mobility~~
  - ~~Multicast support~~
  - ~~Better routing scalability~~
  - ~~Extensibility~~
  - "Stateless auto-configuration"
  - More address space

IPv4 Address Consumption

(from http://www.potaroo.net/tools/ipv4/)
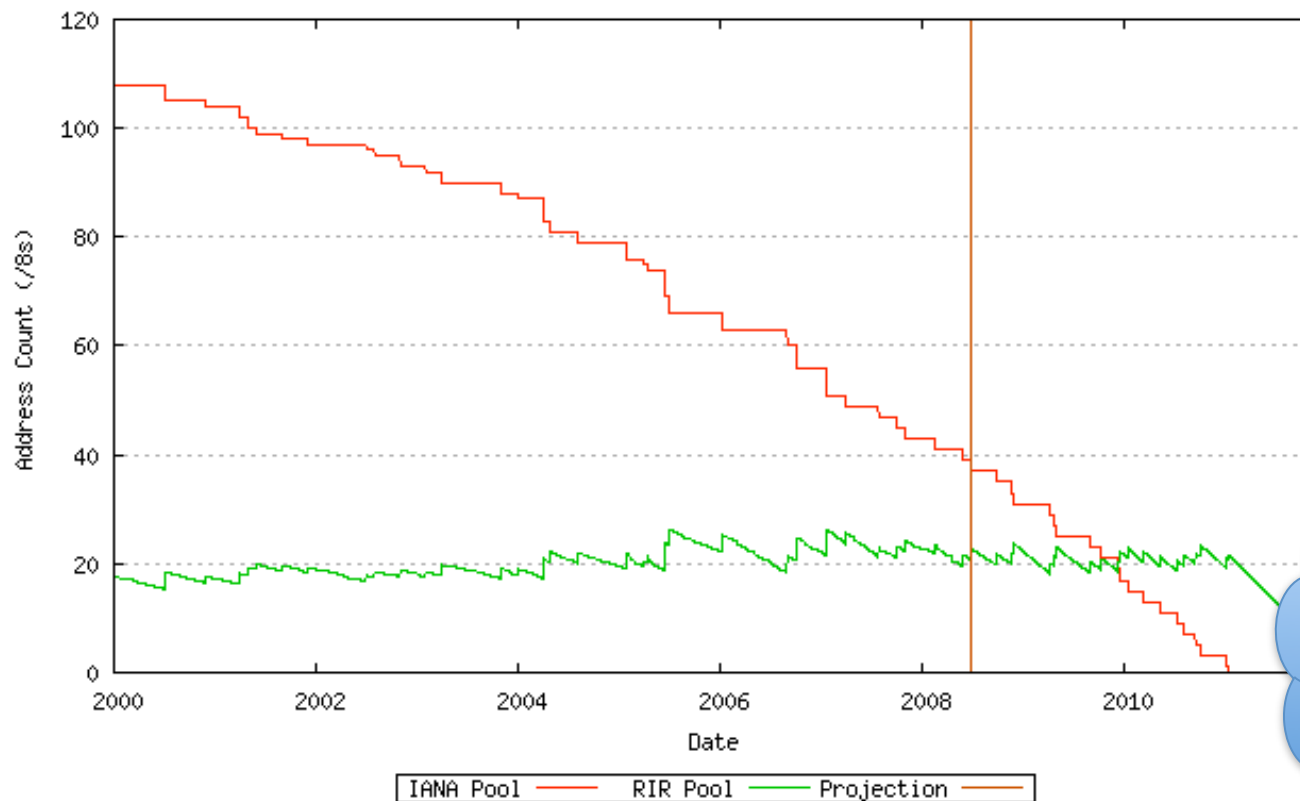
"Here Be Dragons"

- Projected IPv4 free pool "completion" dates:
  - IANA free pool: <u>12 January 2011</u>
  - RIR free pool: <u>28 November 2011</u>
- What happens after?
  - Internet connectivity costs **will** increase, e.g.:
    - Capex: White/Grey/Black market for IPv4 address space
      - Current estimated address utilization efficiency is < 10%
      - Exact scenarios open to debate (to put it mildly)
    - Opex: NAT (upon NAT)
      - How many **public** IP addresses do you *really* need?

Solution: IPv6

- IPv6 solves IPv4's address limitations
- Lots of ISPs now claim to provide IPv6 service
  - Although sales folks might not know it
- Lots of network products claim to support IPv6
  - For some value of "support"
- IPv6-capable services now appearing
  - e.g., root servers, www.icann.org, etc.
- So what's delaying greater acceptance?

A Problem: Compatibility

- There is little between IPv4 and IPv6
  - IPv6 not backwards compatible with IPv4
    - An IPv6 device can't speak directly with an IPv4 device
  - IPv6 not forwards compatible with IPv4
    - An IPv4 device can't speak directly with an IPv6 device
  - APIs are different
    - Applications must be revised
- Analogy: 110 volt devices in a 220 volt country
  - Need transformers (IPv4 ⇔ IPv6: "NAT-PT")

The Vicious Circle

1. End users don't care
   - "What's IP?"
2. ISPs haven't had a reason to support IPv6
   - See #1
3. Content providers haven't needed to provide their content via IPv6
   - See #1
   - Even if #1 was different, see #2
4. Go to 1

Coexistence

- IPv4 is not going to go away on 28 Nov 2011
  - It will just be harder to get
- IPv6 is being supported in the building blocks
  - Vista, XP (sort of), MacOS X, Linux/Unix
  - Cisco, Juniper, Huawei, etc.
- "Dual Stack" transition
  - Both IPv4 and IPv6 running at the same time
  - When destination supports IPv6, it is used
  - Fallback to NAT'd IPv4 when it is not

What's Missing?

- Infrastructure
  - Network Management systems
  - "Customer Premises Equipment"
  - Load balancers
  - Backend systems
    - Customer provisioning
    - Registrar customer facing front-ends
- Software
  - Most applications
- Etc.

Breaking the Vicious Circle

1. End users don't care
   - "What's IP?"
2. ISPs haven't had a reason to support IPv6
   - See #1
3. Content providers haven't needed to provide their content via IPv6
   - See #1
   - Even if #1 was different, see #2
4. Go to 1

ISPs haven't had a reason to support IPv6

- Getting IPv4 address space is going to be more expensive after IPv4 "completion"
- One solution: increased utilization efficiency
  - ISPs move internal infrastructure to IPv6, reusing their IPv4 addresses for customers
    - IPv6 support for customers comes free
  - "Dual stack" customers get public IPv6 and NAT'd IPv4 address space
    - IPv6 content increases since IPv4 content provision via NAT'd address space is more complicated

Implications

- IPv6 maintains (restores) the basic Internet "End to End" architecture
  - **Intelligence at the edges facilitating innovation**
- IPv4, being limited to 4 billion end nodes, cannot grow to meet the world's population, much less the "Internet of things"
  - NAT is a solution, but increases complexity and hence cost and fragility
  - **Impedes growth and innovation**

What Should Businesses Do?

- Ask vendors about their IPv6 roadmap
  - Simply asking the question raises the temperature
- Add IPv6 support as a 'desirable' feature to network service, hardware, and software procurement
- Turn on IPv6 where it's available, e.g., operating systems, routers, web servers, etc.
  - Prepare your support desks for debugging more network problems

Summary

- A transition is approaching, driven by the "completion" of the IPv4 address space

- 3 options:
  - Growth stops
  - Stay with IPv4 and use NAT
  - Move to IPv6

- IPv6 provides the best alternative for continued growth **and** continued innovation

Questions?