Market Viability of IPv6 – Revisited

North American IPv6 Summit

John Curran
President & CEO, ARIN

Market Viability of IPv6 – Revisited

- Quick History of the Internet Protocol

- The Market Viability Requirement for "IPng"

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Quick History of the Internet Protocol

- Internet Protocol version 4 (IPv4, or just "IP")
  - First developed for the original Internet (ARPANET) in spring 1978
  - Deployed globally with growth of the Internet
  - Total of 4 billion IP addresses available
  - Well entrenched; used today by every ISP and hosting company to connect customers to the Internet
  - Allocated based on documented need

- Internet Protocol version 6 (IPv6)
  - "IPng" (aka IPv6) design work started in 1993 when IETF forecasts showed IPv4 depletion between 2010 and 2017
  - Completed, tested, and available for production since 1999
  - Total of 340,282,366,920,938,463,463,374,607,431,768,211,456 IP addresses available
  - Used and managed similar to IPv4

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"Market Viability as a IPng Criteria"

- RFC 1669 (Informational) published in August 1994
- One of 21 inputs received by IPng Directorate as requested via RFC 1550 – "IPng White Paper Solicitation"
- Asserts that "Viability in the Marketplace" is an important requirement for any IPng candidate
- Notes some factors in determining the cost/benefit tradeoff and hence market viability of IPng:

  1. **Will IPng be deployed for new functionality not found in IPv4?**
  2. **Will there be reduced costs by using IPng rather than IPv4?**
  3. **Will existing IPv4 hosts be adding IPng to reach other IPng hosts?**

- Concluded that IPng may not be ambitious enough in the delivery of new capabilities to compete against IPv4 private address use and the inevitable arrival of network address translation devices.

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IPv6 Market Viability – Initial Outlook

Would there be new functionality not found in IPv4?

Apparently not – autoconfiguration, security, etc. were all being made comparable between IPv4 and IPv6

Would there be reduced costs by using IPv6?

Never really expected – need for additional training and configuration implied that increased costs were inevitable

Would IPv4 hosts be adding IPv6 to reach other IPv6 hosts?

Since no dynamic NAT was included in IPv6 for backwards compatibility, IPv6 alone could not be used to provision basic Internet connectivity. This prevented establishing any sizable base of IPv6 hosts before IPv4 runout, and removed nearly all motivation for deployment of IPv6 before runout.

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IPv6 – Solving the ISP's Problem

- The Internet was composed predominantly of leased-line and dial-up customers (i.e. "access" customers), and connecting new customers requires a continuous supply of additional IP addresses.

- IPv6 provided more IP addresses, so meeting that requirement alone was deemed as sufficient to motivate deployment by ISPs. ISPs (not customers) determine network capabilities, so their use of IPv6 would drive vendors to develop the appropriate equipment.

- While IPv6 was supposed to have a "straightforward transition plan from the current IPv4", IETF abhorrence of NAT precluded development of a single consistent solution.

IPv6 versus NAT

- Despite lack of standardization, the use of NAT with IPv4 became quite commonplace in service provider networks, thus raising the question how IPv6 was going to compete with the alternative of adding customers by just extending IPv4 using private address space & layers of NAT…

- The "Extend IPv4 via NAT" approach had many points in its favor: IPv4 traffic is supported on existing equipment, no need for additional training / skill acquisition by personnel, compatibility with existing back-office management & billing systems.

- Prognosis became even more grim for IPv6 adoption… While IPv6 was the technologically "right" solution, using NAT to extend IPv4 looked to be a better business case.

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Global IPv4 Runout – Feb 2011

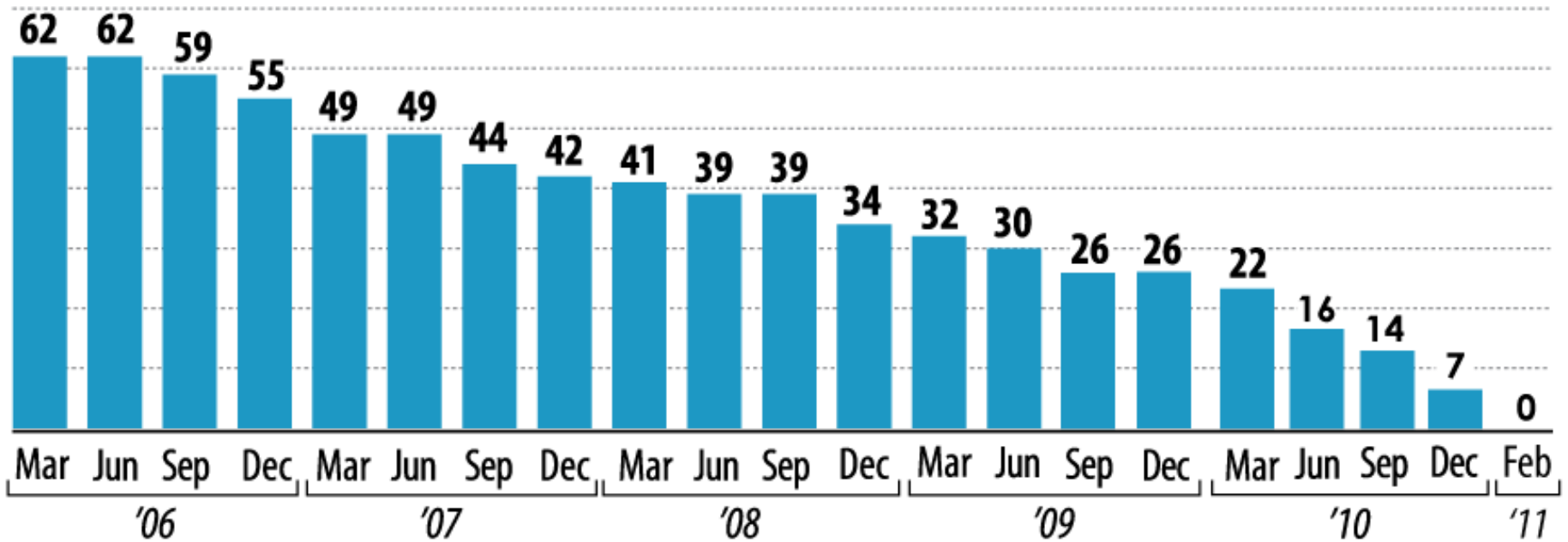Each RIR received its last /8 IPv4 address block from IANA on **3 February 2011.**

ARIN publishes an inventory of available IPv4 addresses, updated daily, at www.arin.net.

Current Estimate to ARIN depletion – Early 2013

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Central IPv4 Free pool - Available IPv4 Space in /8s

IPv6 Market Viability – Revisited

The emergence of the Internet Content industry –

- Internet Content wants <u>quality</u> access to the user including high-bandwidth, low-latency, low-jitter connections and with consistent network identification & location information

- Internet Content increasingly pays the bills via advertising revenue and content sales (music, video, applications, etc.)

Connectivity via layers of NAT simply does not meet Internet Content requirements for service quality –

- With NAT'ed IPv4, as the Internet grows, increasing address & port sharing causes impairment in reliable content delivery

- With IPv6, the end-to-end relationship is maintained and could easily be superior in the very near future

- Increasing plans from major Internet Content providers to be connected via both IPv4 and IPv6…

  e.g. "World IPv6 Launch" event

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IPv6 Market Viability – Revisited

- Internet Content firms are now realizing that service quality requires their hosts to be reachable via both IPv4 <u>and IPv6</u> to preserve the end-to-end model… this finally creates a significant differentiation between the "Private IPv4 + NAT" versus the IPv6 approaches and is driving pre-runout IPv6 demand.

- Service Providers can opt to grow their customer bases via use of "Private IPv4 + NAT", but the bar for basic customer connectivity is higher today, and the user experience over time will not compare to those users with IPv6 end-to-end connections.

- Viability of IPv6 in the marketplace, while not assured, is definitely improving… ☺

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Thanks!

(Q & A?)

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