



Realities of IPv6 as the Future Network Layer

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Introduction and Context

- Renesys provides Internet Intelligence services to service provider and government customers
 - We map the Internet in realtime and help our customers gain business, strategic and technical advantage from that information
 - We are not a service provider
 - We sell no IPv6 hardware
 - We sell no IPv6 migration services
 - We have no dog in this fight
- These are my personal views about IPv6, since Renesys has no official position on the subject.

Overview:

IPv6: Bad Solution to a Non-Problem

- A critical look at whether IPv6 is truly inevitable—separating the vendor and industry buzz from the problematic reality.
- The market has spoken: IPv6 is the wrong technology at the wrong time and most organizations will profit from simply ignoring it.
- Quick review of the most significant problems with IPv6 and why these are barriers to adoption.
- Bet-hedging strategies in case this is wrong.

IPv6: What Was It For?

- The drivers from IPv6 creation, adoption are not purely crass.
- There were (and will be again) good reasons to improve upon the current Internet routing protocol.
- Understanding this involves some basic concepts about Internet technology evolution and governance.

Internet Governance/Technology Basics

- IP addresses come from ICANN to the Regional Internet Registries (RIRs)--AFNIC, APNIC, ARIN, RIPE, LACNIC.
- IPv4 addresses **were** running out. Until:
 - CIDR (non-byte-boundary allocation and subnetting)
 - NAT
 - Strict allocation policies requiring documentation and reuse
- But it was too late, IPv6 engineering had already begun. 10 years later, they just can't stop.

IPv6 Myths and FUD

- IPv4 addresses are running out!
 - They are, but slowly. Current best estimates put the initial exhaustion at June 2013 (Geoff Huston).
 - Can be pushed **much** later with creative policies (address trading market).
 - IPv4 address exhaustion is not the end of the Internet. It's the beginning of a better address utilization strategy.
- IPv4 Allocations are unfair (US-heavy)
 - True. But we did invent the darned thing.
 - Actually a good reason not to move to another network technology (keep home field advantage—selfish).

IPv6 Myths and FUD (2)

- IPv6 is more secure
 - IPsec, invented for IPv6 is in every IPv4 implementation.
- NAT is evil
 - Protocol designers hate NAT but enterprises have managed to build reasonable networks with it.
 - NAT and IPv6 are both evil, but IPv6 is the more dangerous of the two.

IPv6 Myths and FUD (3)

- Everyone (<psst>Asia!</psst>) is moving to IPv6 and the US will be left behind!
 - IPv6 has little or no market adoption anywhere.
 - The largest Asian carriers are still architecting IPv4 networks (and not having problems justifying extremely large allocations).
 - Late migrations to IPv6 will not be penalized or structurally disadvantaged (market dynamics are another story).
 - There is no IPv6 land rush.

IPv6 Myths and FUD (4)

- The US Government has made IPv6 a requirement.
 - The US Federal Government has required hardware vendors to **support** IPv6.
 - Few government agencies have any concrete IPv6 migration plans almost none have working prototype IPv6 networks and none have actually begun a migration.
 - Support of IPv6 is not required for almost any kind of business with the US Federal Government

Who Wants It?

- IPv6 is being promoted by parties that stand to benefit directly from a large-scale network migration:
 - Equipment Vendors (want to sell new hardware, obsolete existing hardware)
 - Contractors (want to get large needs analysis, network engineering and implementation contracts)
- Well-intentioned engineers who believe IPv6 is the right technology.
- Press and politicians searching for an issue.

General Problems with IPv6

- No Migration Strategy
- Bad Hardware Support
- No End-Site Multihoming
- Staff training issues
- [Special] Problems for streaming media
- No Demand

IPv6: Just Another Non-Internet Network

- Backwards compatibility: IPv6 was designed with **no** migration strategy from the real Internet.
 - Tunneling between the two networks is largely manual and capacity-constrained.
 - Routing information is lost across tunnels leading to extraordinarily bad routing.
 - IPv6 is just another non-Internet network protocol, like IPX/SPX, DECNet or Appletalk.

Hardware support

- Stability and security problems
 - Several privilege-escalation and denial-of-service attacks against IPv6 code in routers.
 - Not surprising: big, new chunk of code.
- Performance problems
 - IPv6 line-card support uneven.
 - Process switching is bad (fortunately, there is almost no traffic to move so this is a non-issue).
- No support load balancers / SSL offload devices
 - This is a deal-killer for content providers.

End-Site Multi-homing

- Disallowed under current RIR allocation policies
 - Attempt to control routing table bloat—current IPv4 routing table is 185K entries. Concern that IPv6 could quickly reach 10x that with open allocation policies.
- Shim6 proposal: an evil proposal pushing multi-homing state onto end-site **computers** rather than **routers**
 - Shim6 is dead on arrival and not something anyone should be concerned about.
- Remember Level (3) / Cogent peering debacle?
 - Enterprises even vaguely considering IPv6 need to agitate from true end-site multi-homing.

Training and support

- Network engineers don't know IPv6.
- Slower engineering, troubleshooting.
- Not unique to IPv6—Any new network protocol would face this.

Problems for Streaming Media

- As TDM/Bellheads will tell all of us, packet-switched networks are inefficient (per stream) at moving realtime data streams.
- The issue: packets need headers to be reassembled at the other end
- IPv4 header: 20+ bytes
- IPv6 header: 40 bytes
- Trouble for voice, not for video.

Real Problem: No One Wants/Needs It

- [Probably as a result of the lack of a migration strategy], there is no widespread demand for IPv6.
- The FUD isn't sticking—no one is panic-implementing IPv6.
- Content providers see no customers.
- Customers see no content.
- Everyone who does migrate gets worse performance for far, far fewer native network peers than before.

Recommendations for IPv6:

- General:
 - Pay attention. Stupider things have happened in the past and conditions could change quickly.
 - Educate yourself: learn about the technology and how it might apply to your needs/uses.
 - Agitate: make sure your problems are being addressed by standards committees (multi-homing) and vendors. Advocate for practical solutions rather than the IPv6 boondoggle.
 - Remain skeptical: until you see a real requirement for IPv6 in your business, don't be taken in by the FUD.



Thanks

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