

IPv6 at takeoff speed

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Topics

- Where IPv6 is today
- Myths
- Open questions
- The IPv6 opportunity

IPv6 today: brief history

- We knew in 1992 that the Internet was poised for takeoff
- Requirements for IPng, and candidate solutions, were identified in 1993-4
 - 15 to 20 year process was expected
- Direction was set at Toronto IETF, July 1994
- First Proposed Standard in December 1995
- First commercial host stack in 1997
- Stable base spec since 1998
 - of course, constant evolution of associated specs

IPv6 today: a proof point

- This week is the final week of the EU 6NET project (<http://www.6net.org>)
- Quotes from final deliverables:
 - "...all the major basic networking services were studied, tested and deployed ... IPv6 is a smooth running technology, with unparalleled scalability, and with a growing number of providers and users."
 - "Although some amount of programming and configuration work was involved for each application or package, it can be stated that no fundamental difficulties were encountered. Moving the applications environment to IPv6 is generally a straightforward process, and bridging to the IPv4 legacy is only slightly more challenging. "

Implementation status

- All significant operating systems and router vendors now support dual IPv4/IPv6 stacks and socket APIs
- BIND DNS, PowerDNS, djbdns support IPv6
- Linux Mobile IPv6 support
- Java 1.4 and later supports IPv6
- Many public domain applications support IPv6
- The conversion of commercial applications is beginning
 - e.g. IBM Websphere Application Server 6

Major technical benefits of IPv6

- Enough address space to provide unique addresses for billions of devices
- No need for address translation
- Address structure that facilitates large subnets
- Facilities for convenient auto configuration (or managed configuration if preferred)
- Potential for better route aggregation
- Simplified header format with clean extensibility
 - allows effective header compression
- Provision for a QOS flow label

IPv6 is a conservative design

- Like IPv4, this is a connectionless datagram protocol designed for dynamic rerouting
 - Like IPv4, IPv6 can run over many substrates, such as MPLS, and can survive partial infrastructure failure
- No change in the Internet end to end principle that end systems are primarily responsible for session integrity
 - Like IPv4, IPv6 can benefit from QOS and security enhancements in network, but does not require them
- No change in site or wide area routing concepts
 - Route scaling therefore requires topologically assigned address prefixes

Avoid myths: address magic

- Having 128 bit addresses doesn't allow 2^{128} devices
 - address structure eats up bits; wise allocation policies are needed
- Having enough address space doesn't restore end to end transparency
 - firewalls are here to stay, and some operators are tempted by walled garden models
- Having enough address space doesn't allow for geographical addressing
 - topological addressing is here to stay unless a fundamentally new routing mechanism is invented

Avoid myths: security magic

- Restoring globally unique addressing indeed allows more widespread use of IPsec
 - but it will not remove the key management and performance issues for Layer 3 encryption
 - it will not change anything in Layer 1, 2, 4 or applications and systems security
- Effort has gone into privacy and traceability issues for IPv6, but address privacy has little impact on user-level privacy concerns

Avoid an inverse myth: NAT magic

- IPv4 Network Address Translators are often touted as security solution
- All their claimed security benefits can be provided in an IPv6 environment without address translation
 - (Current work in progress in the IETF)

Avoid myths: QoS magic

- IPv6 and IPv4 share all existing quality of service technology
- The IPv6 Flow Label holds potential for improving some aspects of end to end QoS, but the use cases are still for further study

Main open questions

- Tune RIR address assignment policies to avoid waste and support growth and innovation
 - including specific measures to avoid unfairness to entry-level regions
- Completion of technical solution for site multihoming
- Finding the trigger for the business case
- For a practical list of technical matters, see 6NET deliverable D2.5.3: *Final Report on IPv6 Deployment Issues* at <http://www.6net.org>

The IPv6 opportunity:

Critical advantages in a services architecture

- 10 billion nodes squeezed into 4 billion IPv4 addresses – why would we do that?
- Unique global addressing eliminates the problem of ambiguous “private” addresses
 - Potential for massive scaling
 - Avoid interworking units
 - Autoconfiguration and ample addresses are a big plus for flexible infrastructure configuration
- Strategic benefit for the next 50 years at least
 - avoid the opportunity cost of staying with IPv4

How to make the business case

- Avoid mistakes of the past
 - "Grand plans" and attempted mandates like "OSI everywhere" or "ATM everywhere" almost always fail
 - The real drivers are a subtle combination of engineering, business and regulatory factors
 - *Good engineering with a stable base*
 - *Clear thinking about the business model*
 - *Very light regulation, only to ensure a level playing field*
 - Let IPv6 find its own market