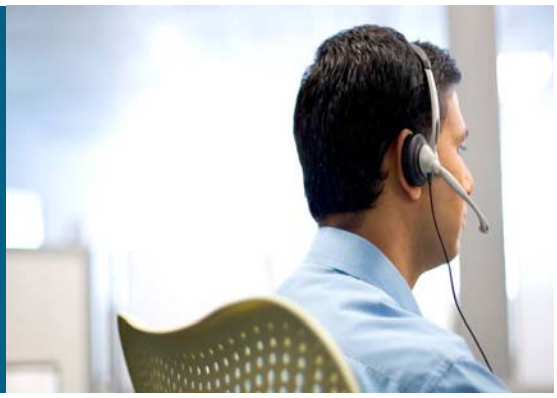
IP Version Agnostic Networks

Service realities and lessons learned



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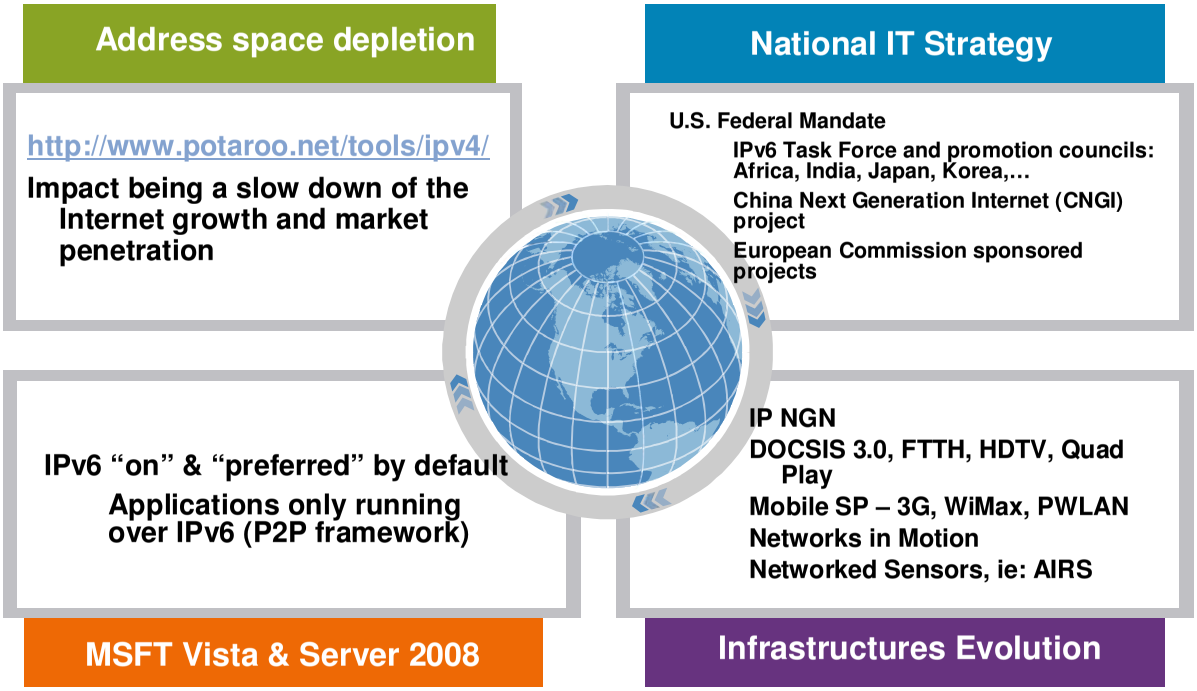
Observed Perspectives on IPv6

Monitoring Market Drivers



Adoption Perspectives

- Today's IPv6 deployment drivers do not rely on uncovering the "future killer application" anymore, they focus instead on:

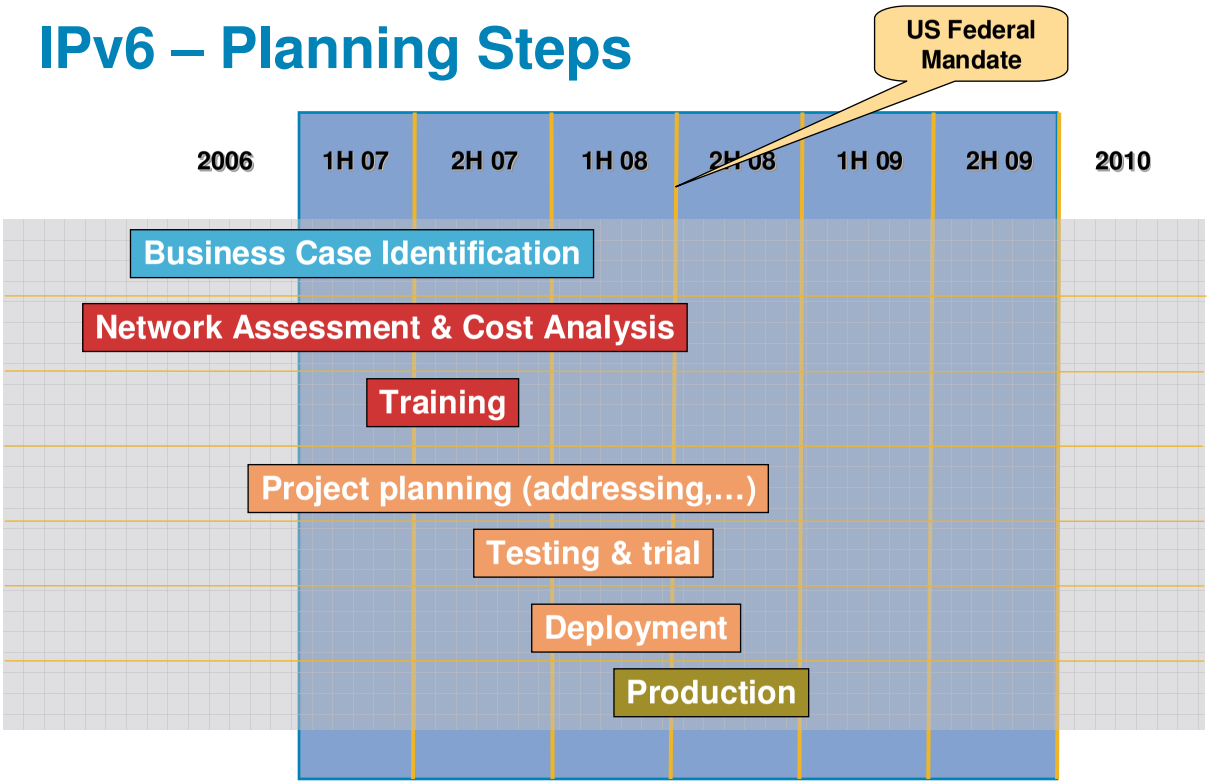
  - Performing the same as IPv4 but on a larger scale
  - Operational cost savings or simpler network models when deploying applications
  - Leading the innovation – no IP legacy

- Observations on adoption drivers:

  - Service Providers can clearly identify IPv6 drivers focusing on Consumer markets (Broadband or Mobile)
  - Enterprises may slowly adopt IPv6 based on new OS/Applications environment, regional presence or vertical market mandate

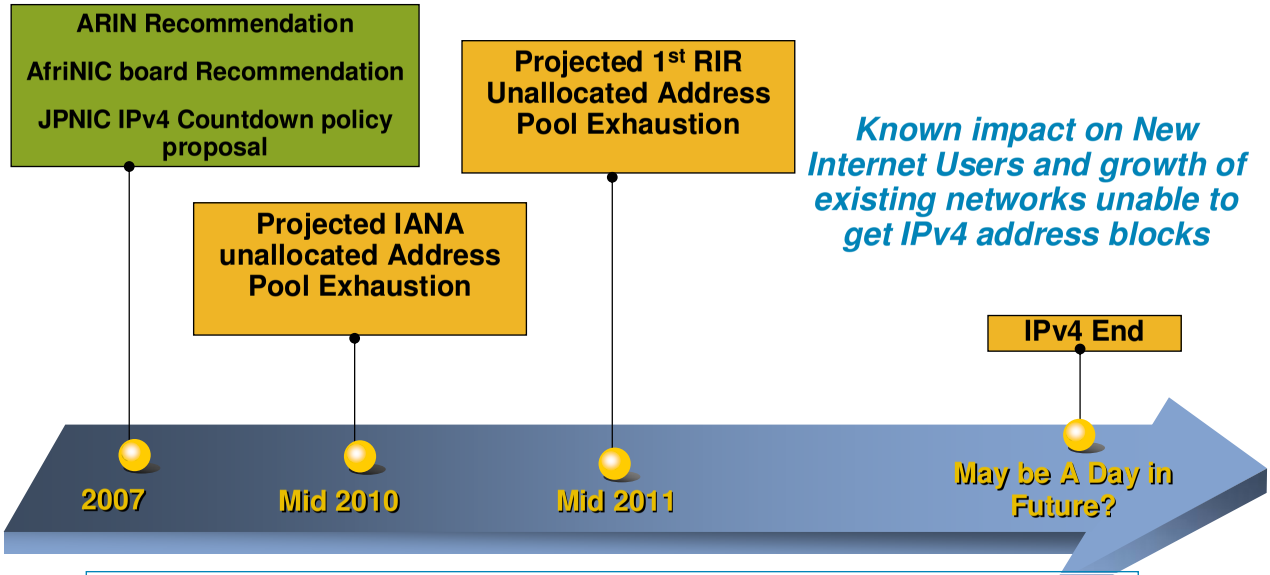
- Adoption requires organization wide coordination amongst departments and projects

IPv6 – Planning Steps



How much time is needed for each phase of YOUR IPv6 deployment?

Impact of IPv4 Address Space Exhaustion

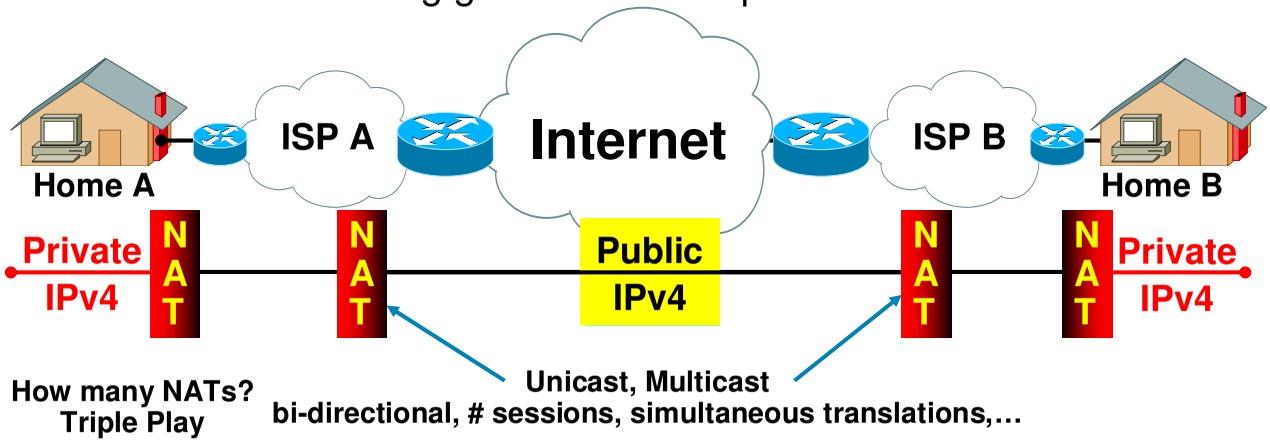


Known impact on New Internet Users and growth of existing networks unable to get IPv4 address blocks

Whatever happens, today's IPv4 Internet will continue to run as is – but several layers of NAT may restrict applications deployment while costs associated with IPv4 addresses will increase

Dealing with IPv4 Address Space Constraints

- Enterprises are not exempt from the addressing constraints (increasing numbers of devices, multiple overlays, merging, etc)
- Adopting IPv6 is a relief for the address space exhaustion however, Internet Access remains IPv4 focused
  - Many IPv4 appliances will exist for long time unless incentives are created to get end-users to upgrade them
- NAT solutions in Service Provider networks will be needed to get more out of the existing global address space



Deploying IPv6

Common Deployment Scenarios

	Environment	Scenario	Cisco IOS support
Core	Native IP – Core is IPv6 aware	Dual Stack	Yes
	MPLS – Core is IPv6 unaware	6PE/6VPE	Yes
WAN	IPv6 services on L3 Managed Services	Dual Stack	Yes
	IPv6 over L2 services	Dual Stack	Yes
Campus	L3 infrastructure – IPv6 capable	Dual Stack	Yes
	L3 infrastructure – not IPv6 capable, or sparse IPv6 hosts population	ISATAP	Yes
Less optimum	IPv6 over IPv4 tunnels	Scalability & Management	Yes
	Translation (NAT-PT)	Scalability, adaptability,…	Yes

IPv6 Addressing & Routing

- Globally routable prefixes are managed by RIR (~1800 allocated)
  - Private address space (ULA) is not really deployed and the implications of its use are still analyzed – Will IPv6 NAT emerge?
  - Provider Independent address space is still not available across all RIRs – ie: RIPE. Some organizations did however acquire PI space.
- Education is required to ensure an optimal Global IPv6 Internet routing table (http://www.space.net/~gert/RIPE/ipv6-filters.html)
  - Small number of prefixes in intranets (aggregation) on Internet (most deployments not opened to the Internet)
  - Still a long way to the number of routes that can be handled by routers today
- Corporate addressing scheme and policy best practices still being developed:
  - All subnets /64 vs more variability in subneting
  - Stateless vs DHCPv6 auto-configuration
  - EUI-64, Privacy Extensions, CGA for Interface Identifiers

Understanding co-existence implications

- Resources considerations

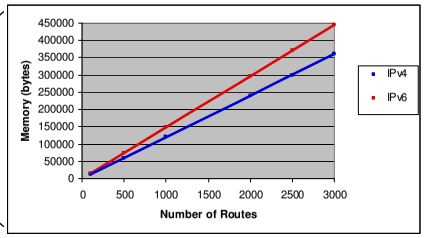
  - Memory (storing the same amount of IPv6 routes requires less memory than might be expected)
  - CPU (insignificant increase in the case of HW platforms, additive in the case of SW platforms)

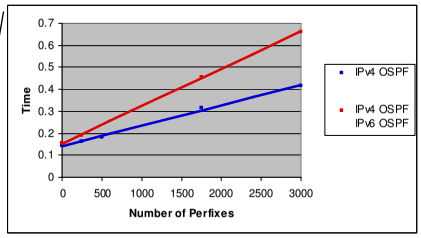
- Control plane considerations

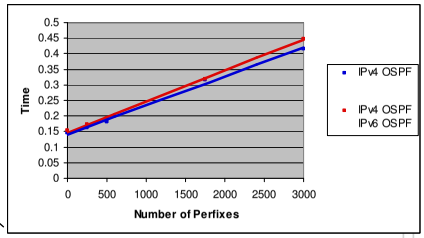
  Balance between IPv4/IPv6 control plane separation and scalability of the number of sessions

- Performance considerations

  - Forwarding in the presence of advanced features
  - Convergence of IPv4 routing protocols when IPv6 is enabled







Running IPv6

Transition of back-end systems

- Deployment of IPv6 requires upgrades to back-end systems (OSS)
  - Display of IPv6 addresses in GUIs; replace use of IP addresses with DNS
  - Integration of IPv4/IPv6 addresses into any information management
  - Extension of device/service/subscriber identification to allow for IPv6 addresses
  - Coordination between multiple IP addresses assigned to a device
  - IPv6 transport may be required even in dual-stack network - for example, communication with IPv6-enabled cable modems
- BIS/BIW/ALG/NAT-PT may be useful, but applicability is limited
  - Applications and services using embedded addresses require PDU translation
  - Finding all the places where addresses are translated may take a lot of work
  - Resulting system is more difficult to provision/maintain/troubleshoot

IPv4/IPv6 Management

- Key issue: *How to manage IPv4/IPv6 dual-stack network without more than 2x operational expense?*
- Requires support in:
  - Instrumentation (MIB , Netflow records, etc)
  - Applications running over IPv6 (SNMP, TFTP, Syslog, etc)
  - NMS tools and systems
- Support across all elements and functions remains incomplete
- Network Management is often times viewed as a good first “service” offered over an IPv6 enabled infrastructure

IPv6 Security

- The insertion of devices implementing dual-stack becomes a major concern:
  - Monitoring protocol port 41
  - Monitoring DNS AAAA records access
  - Setting-up rules which allow tighter control
- IPv6 is not identical to IPv4 so a review of the current architectures is necessary to understand the possible impact of integrating IPv6
  - Host ACL may not be appropriate – multiple addresses per interface, privacy
  - Secure Neighbor Discovery may enable new security designs at link level
- Lack of specific feature set implementation still represents a transitional security weakness

Summary

Market Perspective

Internet growth and innovation through the adoption of new technologies is a multi-year, complex integration process

Software Developer Perspective

Applications must be "*IP version agnostic*"

Network Manager Perspective

Service providers have real, specific drivers today
Enterprises developing adoption business cases
Parity with IPv4 is not the goal. New architectures scaling for the customer and service needs

The End-User Perspective

Applications and Services need to be IP version transparent

Q and A

Cisco Press Books