



ARIN NANOG

ON THE ROAD

Orlando, Florida
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Moving to IPv6

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Agenda

- ARIN's current IPv4 inventory
- Observation of current V6 deployment status
- ARIN's efforts to run IPv6 historically

Current IPv4 Inventory

Available inventory:

.33 /8 equivalent



Reserved inventory:

- **~22.53 /16 equivalents held** in “quarantine”
(returned, revoked, held space)
- **1 /10** for NRPM 4.10 “Dedicated IPv4 block to facilitate IPv6 Deployment”
- **220 /24s** for micro allocations

ARIN's IPv4 Free Pool

- 4 ways that IPv4 addresses go back into ARIN's free pool
 - Return = voluntary
 - Revoke = for cause (usually non-payment)
 - Reclaimed = fraud or business dissolution
 - IANA issued – per global policy for “post exhaustion IPv4 allocation mechanisms by IANA”
- 3.54 total /8s recovered since 2005
 - /8 equivalent returned to IANA in 2012
- /11 (May 2014) & /12 (Sept 2014) issued by IANA

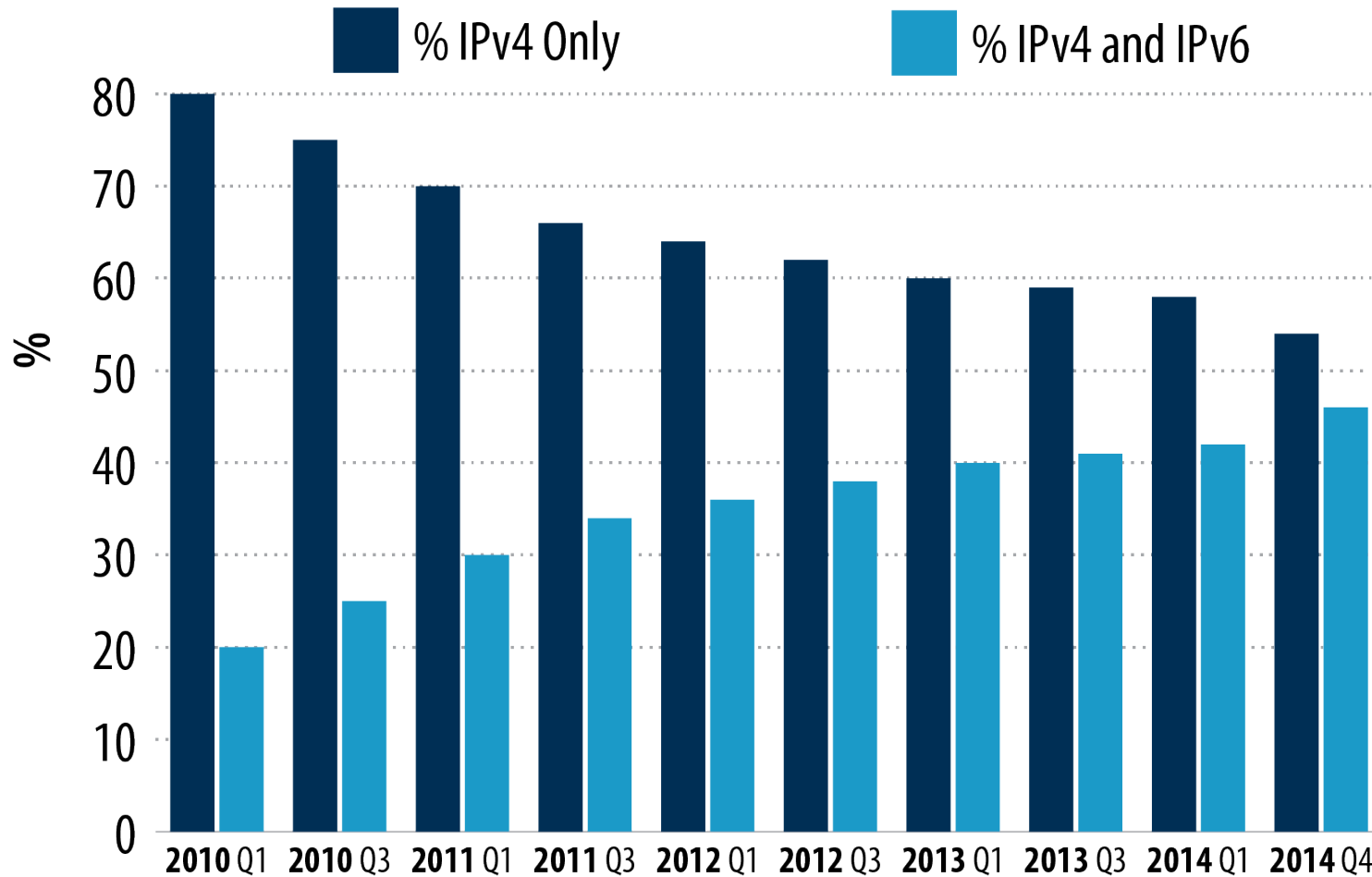
Trends and Observations

- Comparing the past 12 months over the 12 months prior:
 - 18% increase in IPv4 requests
 - 5% increase in Transfer requests
 - 8% decrease in IPv6 requests

IPv4, IPv6 & Transfer Requests

	IPv4 Requests	IPv6 Requests	Transfer Requests (NRPM 8.2,8.3 & 8.4)
2011	2,863	1,425	446
2012	2,974	878	504
2013	3,377	771	539
2014	3,634	710	571

ISP Members with IPv4 and IPv6



4,960 subscriber members as of 13 February 2015

Options for Growing Your Network after IPv4 Depletes

- Check ARIN inventory to see if there is any space available
- Go on waiting list and hope that space comes back to ARIN
- Explore market transfers (use STLS)
- Request IPv6

ARIN's IPv4 Inventory

As of Feb. 19, 2015, ARIN has 0.33 /8 equivalents of IPv4 address space remaining

IPv4 inventory published on ARIN's website: www.arin.net



Updated daily @ 8PM ET

IPv4 Waiting List

- Starts when ARIN can't fill a justified request
 - Option to specify smallest acceptable size
 - If no block available between approved and smallest acceptable size, option to go on the waiting list
- Oldest request filled first
 - If ARIN gets a /16 back and the oldest request is for a /24, we issue a /24 to that org
- Limit of one allocation every 3 months

Types of Transfers

- Mergers and Acquisitions (NRPM 8.2)
- Transfers to Specified Recipients (NRPM 8.3)
- Inter-RIR transfers (NRPM 8.4)

Transfers to Specified Recipients (NRPM 8.3)

- 12 month waiting period (anti-flip provision)
- Recipient must qualify to receive resources under current ARIN policy
- Recipient may receive up to a 24 month supply

Inter-RIR Transfers (NRPM 8.4)

- RIR must have reciprocal, compatible needs-based policies
 - Currently APNIC, soon to be RIPE NCC
- Transfers from ARIN
 - Source cannot have received IPv4 from ARIN 12 months prior to transfer or receive IPv4 for 12 months after transfer
 - Source must be legitimate holder of space
 - Recipient meets destination RIR policies
- Transfers to ARIN
 - Recipient meets ARIN policies

Specified Transfer Listing Service(STLS)

- 3 ways to participate
 - Listers: have available IPv4 addresses
 - Needers: looking for more IPv4 addresses
 - Facilitators: available to help listers and needers find each other
- Major Uses
 - Matchmaking
 - Obtain pre-approval for a transaction arranged outside STLS
 - Pre-approval is based on 24 month demonstrated need

Reality Check

- Reports say current asking prices are around \$10/IPv4 address
- Prices will likely rise once ARIN's depletes its IPv4 pool (supply and demand)
- Supply not guaranteed; need willing participants
- Temporary measure; does not preclude need to transition to IPv6
- IPv6 is abundant and easy to qualify for!

Qualifying for IPv6 - ISPs

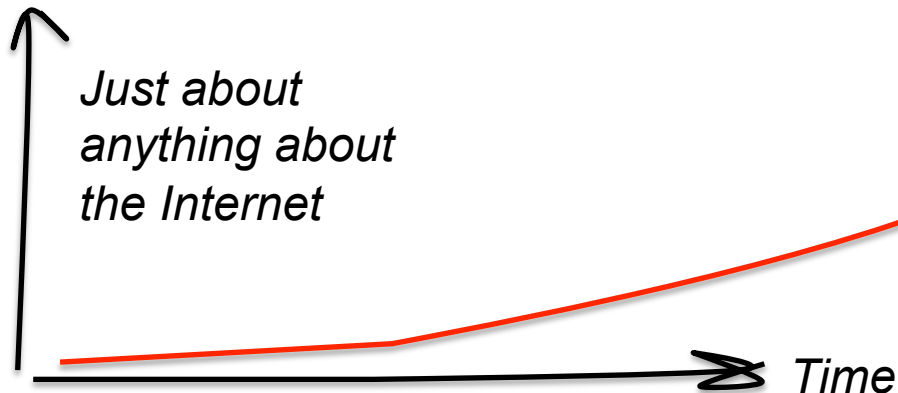
- Have a previous v4 allocation from ARIN **OR**
- Intend to multi-home **OR**
- Provide a technical justification which details at least 50 assignments made within 5 years

Qualifying for IPv6 – End Users

- Have a v4 direct assignment **OR**
- Intend to multi-home **OR**
- Show how you will use 2000 IPv6 addresses or 200 IPv6 subnets within a year **OR**
- Technical justification as to why provider-assigned IPs are unsuitable

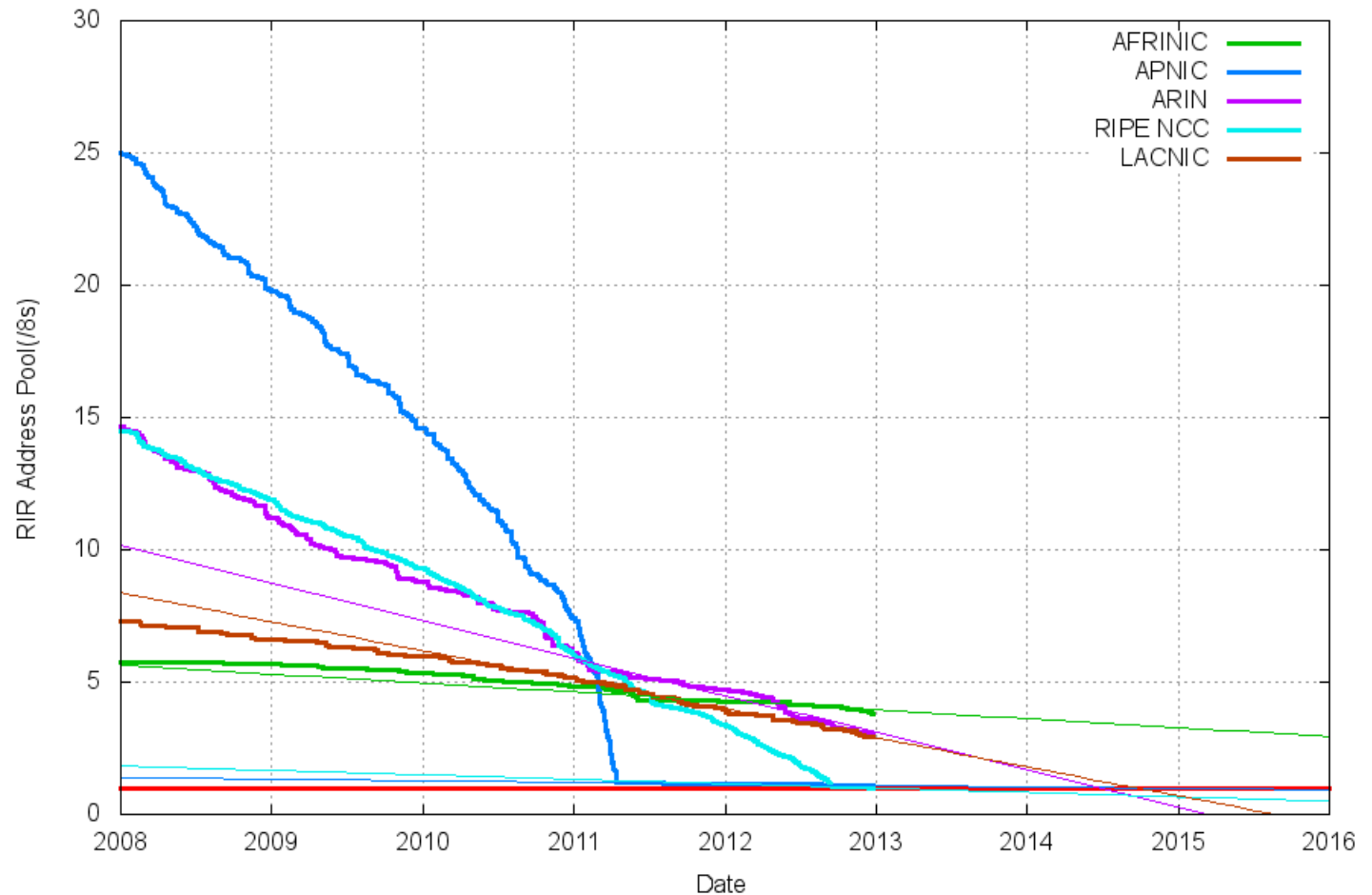
The Amazing Success of the Internet

- 2.3 billion users!
- 4 online hours per day per user!
- 4% of the world GDP

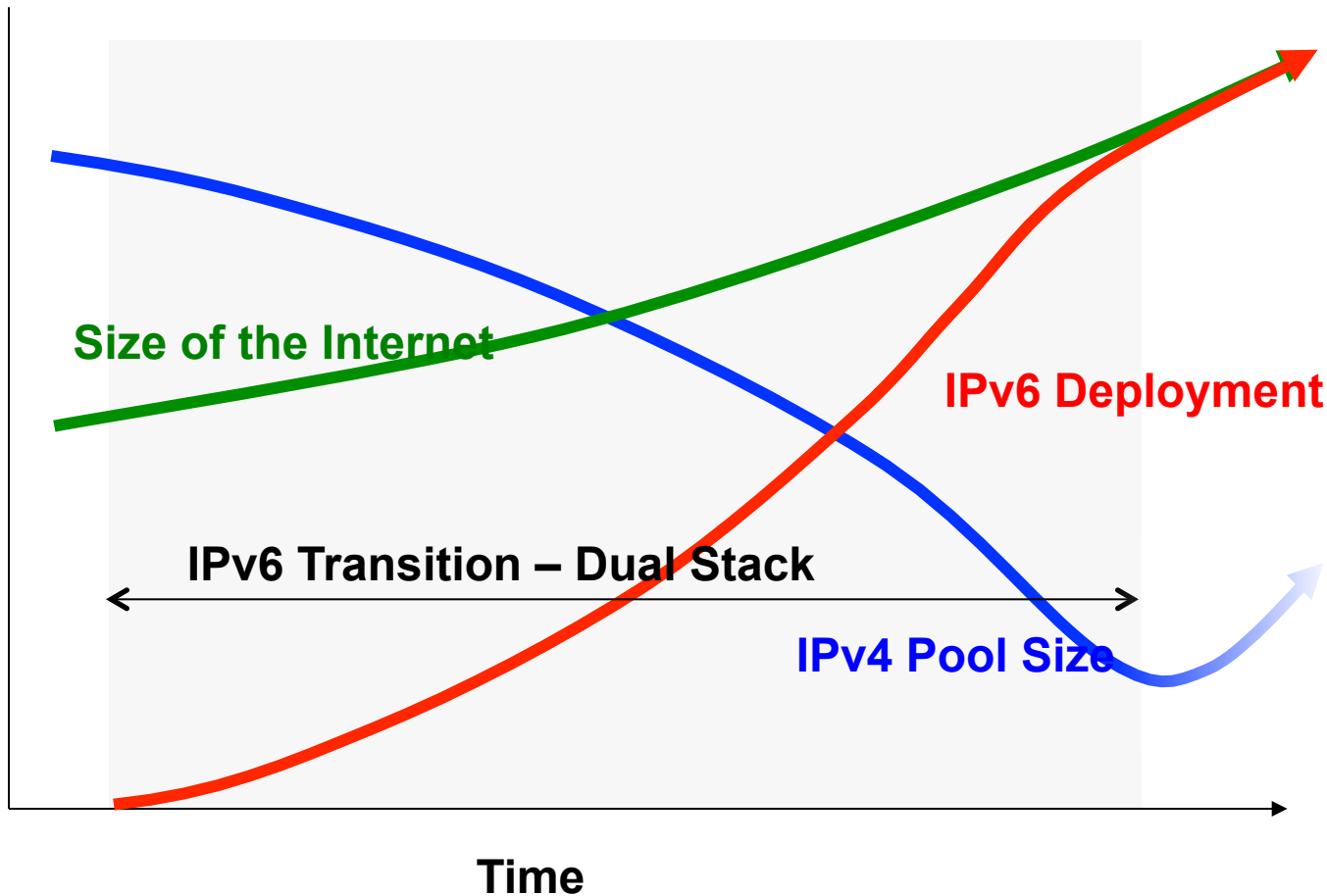


Success-Disaster

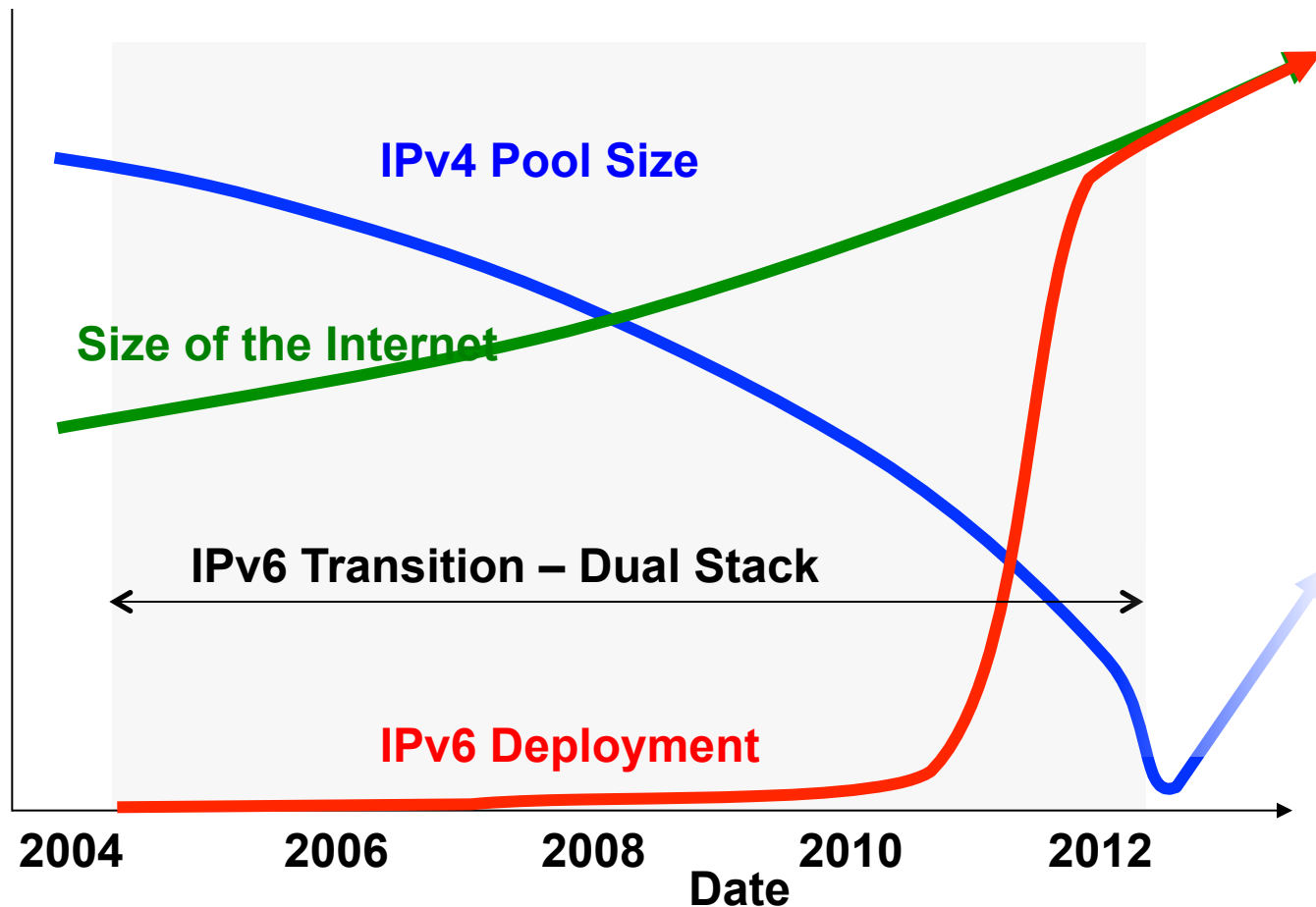
RIR IPv4 Address Run-Down Model



The Original IPv6 Plan - 1995



The Revised IPv6 Plan - 2005

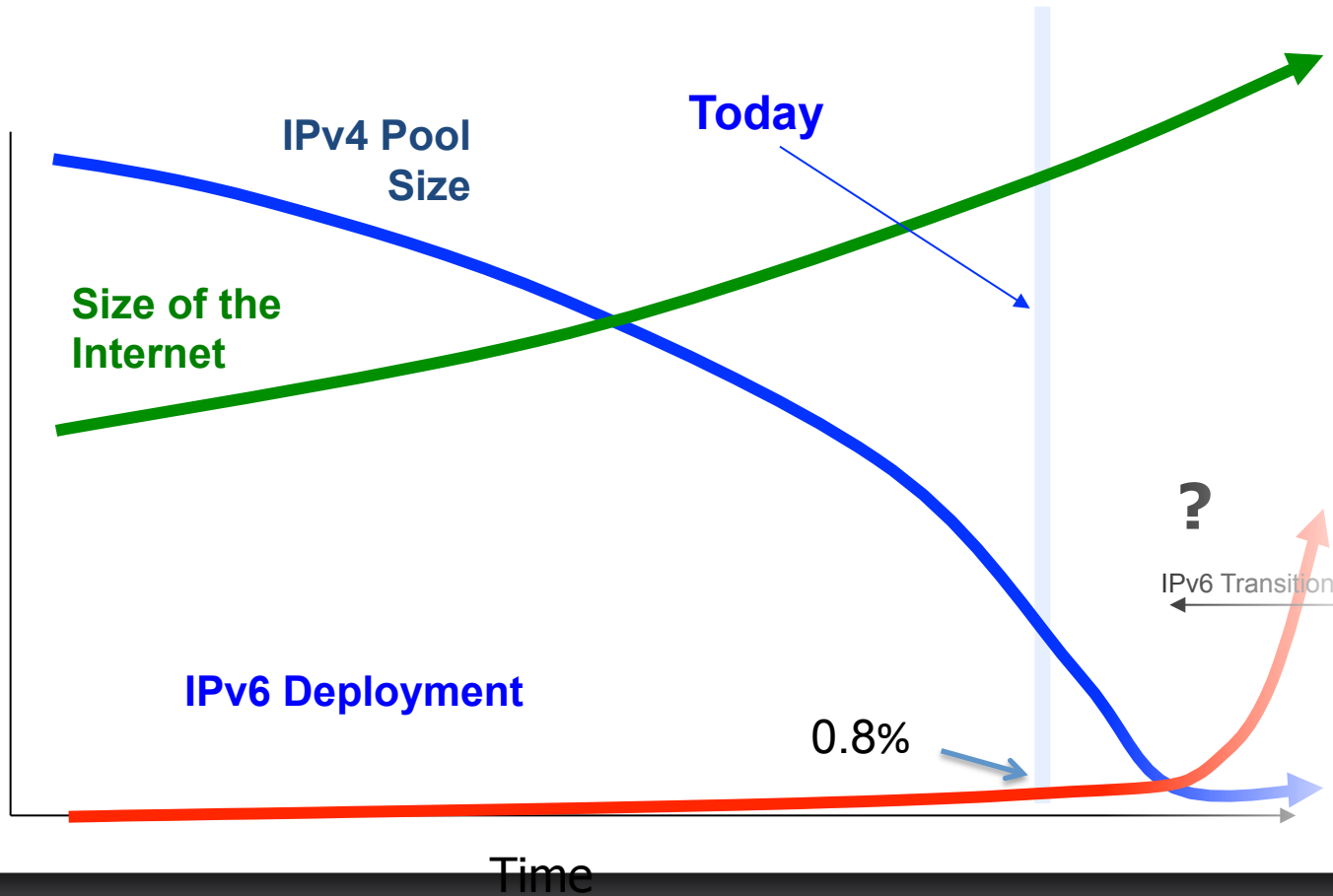


Oops!



We were meant to have completed the transition to IPv6 BEFORE we completely exhausted the supply channels of IPv4 addresses!

Today's Plan



Transition ...

The downside of an end-to-end architecture:

- There is no backwards compatibility across protocol families
- A V6-only host cannot communicate with a V4-only host

We have been forced to undertake a Dual Stack transition:

- Provision the entire network with both IPv4 AND IPv6
- In Dual Stack hosts configure the hosts' applications to prefer IPv6 to Ipv4
- When the traffic volumes of IPv4 dwindle to insignificant levels, then its possible to shut down support for IPv4

Dual Stack Transition ...

We did not appreciate the operational problems with this dual stack plan while it was just a paper exercise

- The combination of an end host preference for IPv6 and a disconnected set of IPv6 “islands” created operational problems
 - Protocol “failover” from IPv6 to IPv4 takes between 19 and 108 seconds (depending on the operating system configuration)
 - This is unacceptably slow
- Attempting to “bridge” the islands with IPv6-in-IPv4 tunnels created a new collection of IPv6 path MTU Discovery operational problems
 - There are too many deployed network paths contain firewall filters that block all forms of IMCP, including ICMP6 Packet Too Big
- Attempts to use end-host IPv6 tunneling also presents operational problems
 - Widespread use of protocol 41 (IP-in-IP) firewall filters
 - Path MTU problems

Dual Stack Transition

Signal to the ISPs:

- Deploy IPv6 and expose your users to operational problems in IPv6 connectivity

Or

- Delay IPv6 deployment and wait for these operational issues to be solved by someone else

So we wait...

And while we wait...

The Internet continues its growth

- And without an abundant supply of IPv4 addresses to support this level of growth then the industry is increasingly reliant on NATs:
 - Edge NATs are now the defacto choice for residential broadband services at the CPE
 - ISP NATs are now the defacto choice for 3G and 4G mobile IP services

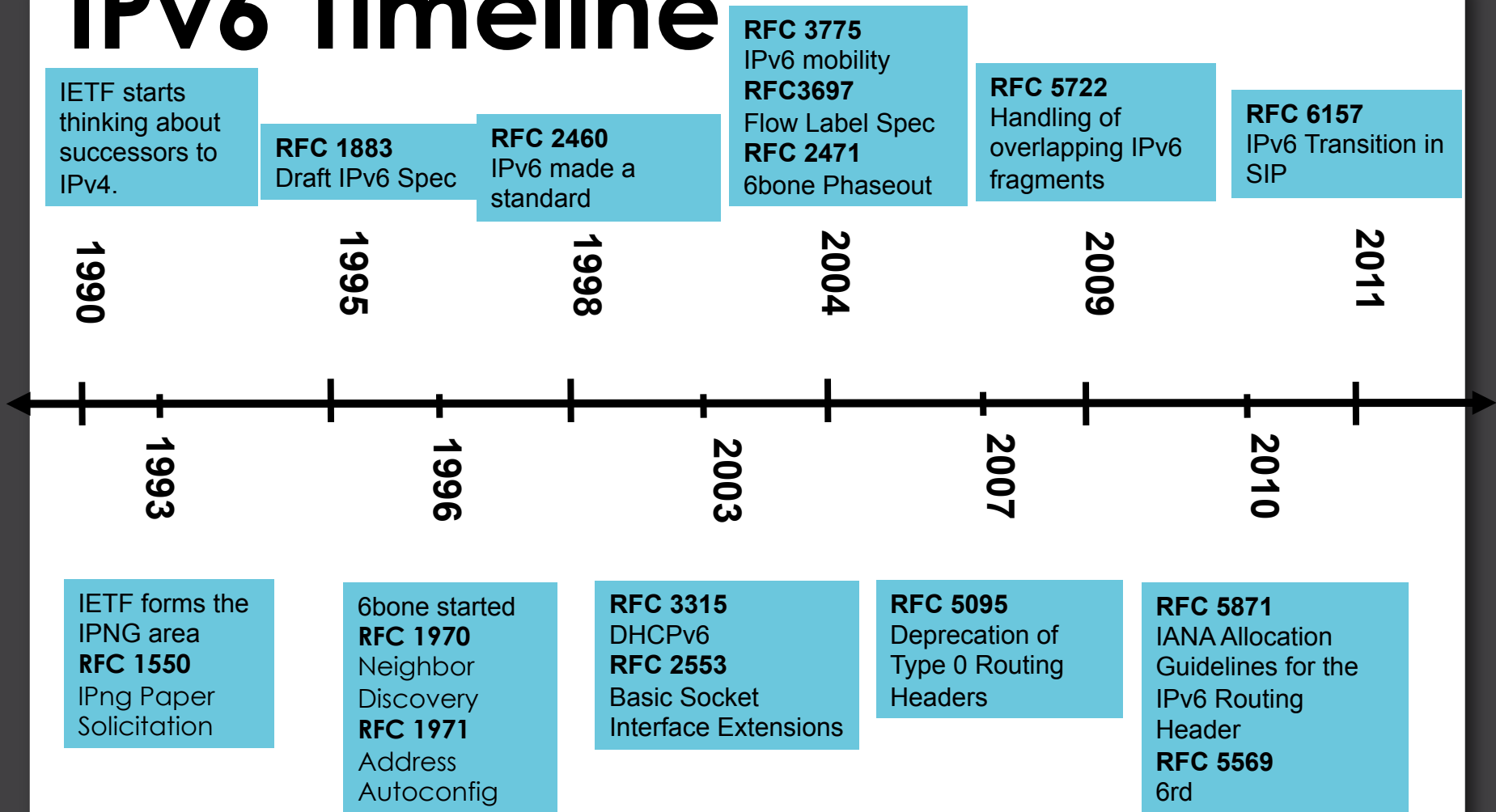
What ARIN is hearing from the community

- Movement to IPv6 is slow
 - Progress is being made
 - ISP's carefully rolling out IPv6
- Lots of ISPs purchasing CGN boxes
- There is a black market for IP space
 - Rent by month
 - Purchase outright

No Real Driver for Immediate IPv6

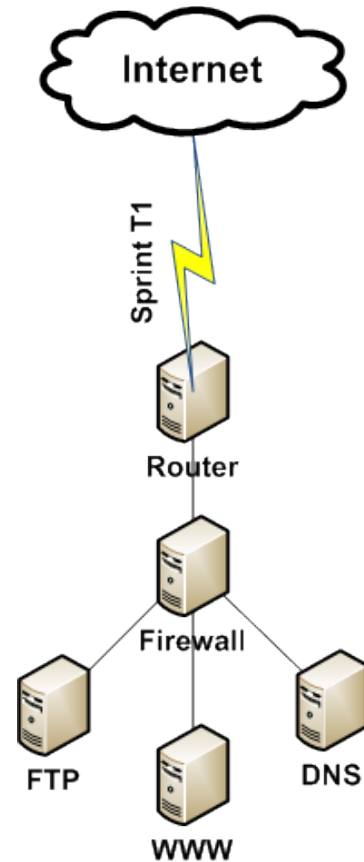
- IPv6 gives you better security – FALSE
- IPv6 gives you better routing – FALSE
- IPv6 has better applications – FALSE
- IPv6 is more flexible on network changes -
MAYBE
 - RA vs DHCPv6
- IPv6 has more address bits – TRUE
- Therefore IPv6 is really IPv4 with more bits
- Requires effort to build deploy

IPv6 Timeline



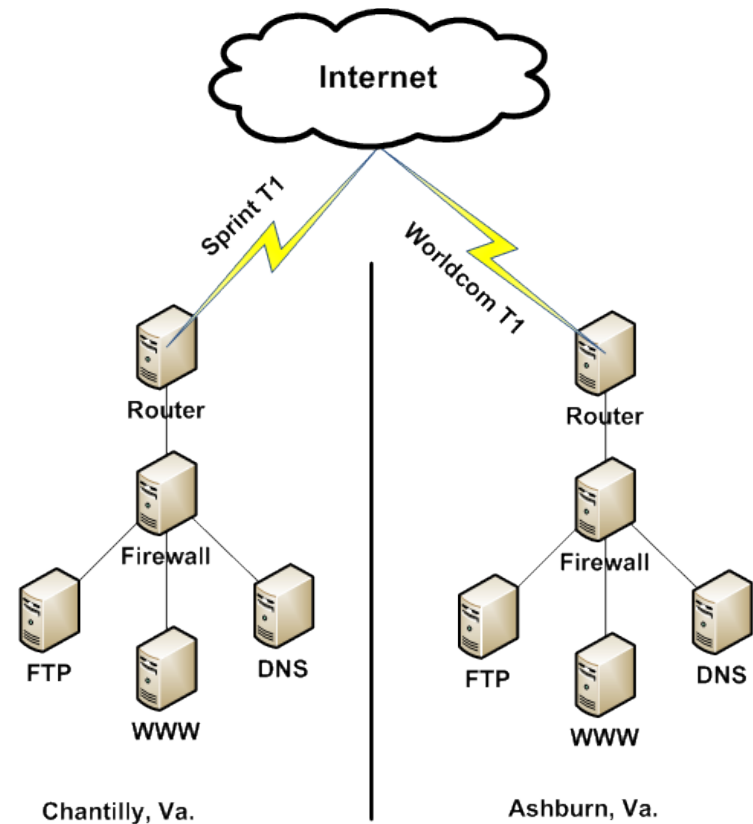
2003: Sprint

- T1 via Sprint
- Linux Router with Sangoma T1 Card
- OpenBSD firewall
- Linux-based WWW, DNS, FTP servers
- Segregated network no dual stack (security concerns)
- A lot of PMTU issues
- A lot of routing issues
- Service did improve over the years



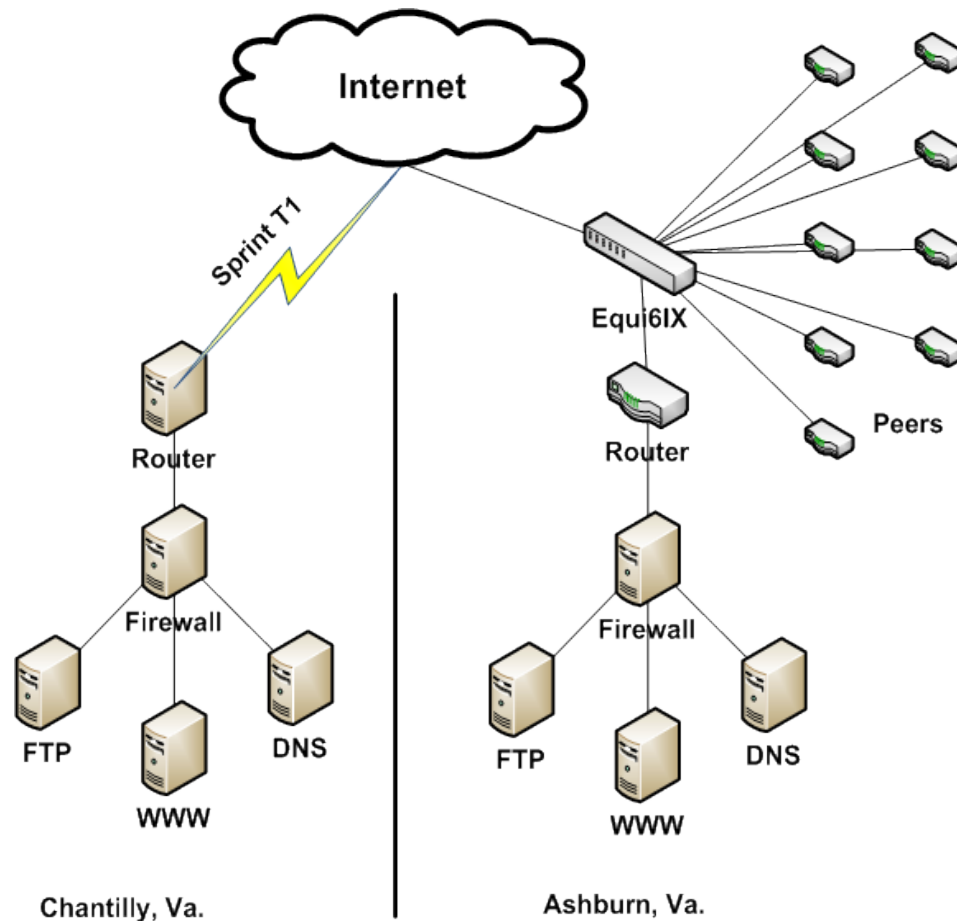
2004: Worldcom

- T1 via Worldcom in Equinix
- Cisco 2800 router
- OpenBSD firewall
- Linux-based ww6, DNS, FTP servers
- Segregated network no dual stack (security concerns)
- A lot of PMTU Issues
- A lot of routing issues



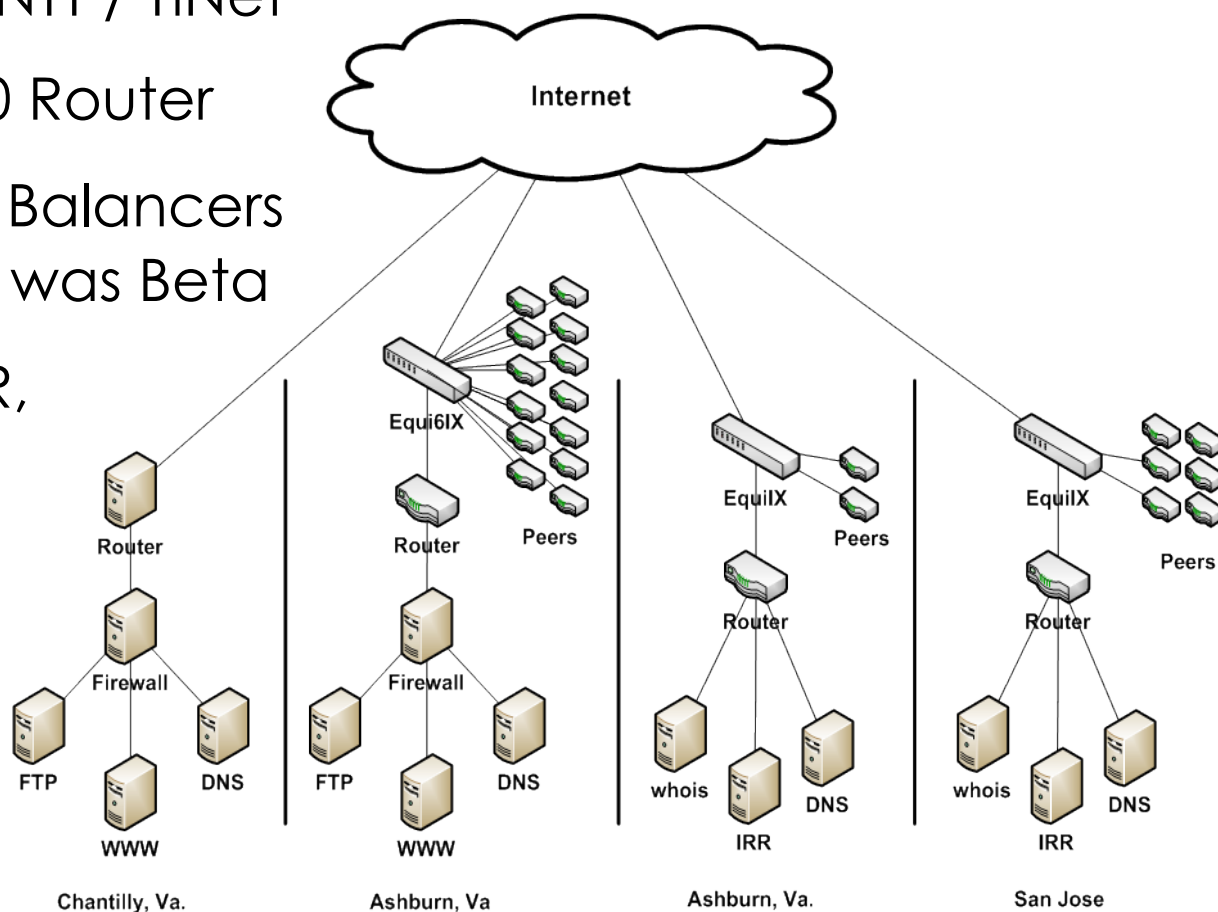
2006: Equi6IX

- 100 Mbit/s Ethernet to Equi6IX
- Transit via OCCAID
- Cisco 2800 router
- OpenBSD firewall
- WWW, DNS, FTP, SMTP
- Segregated Network
- Some dual stack



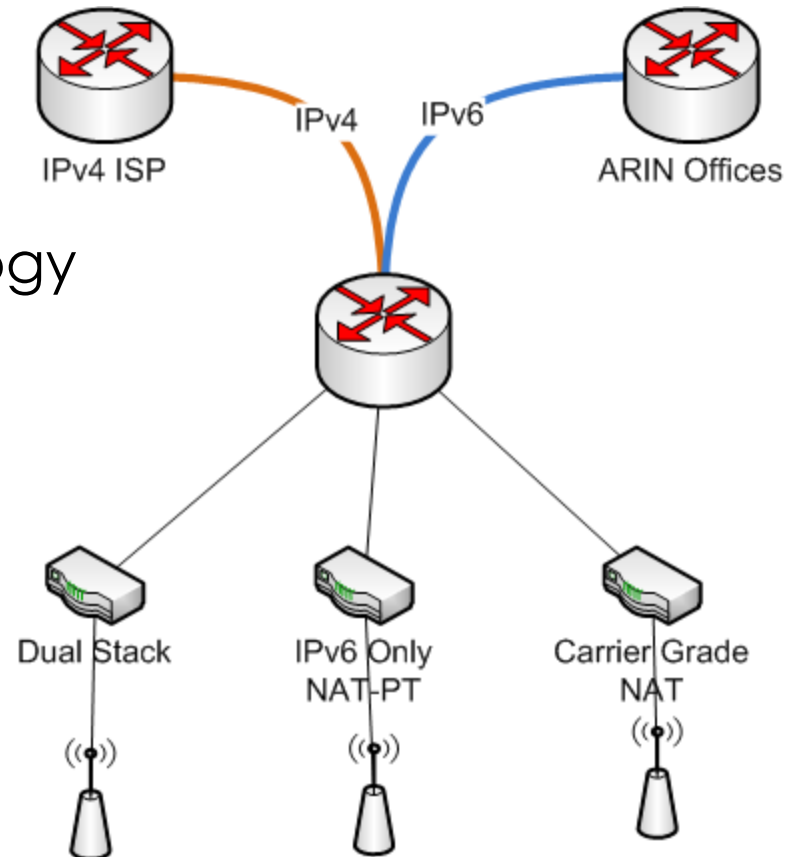
2008: NTT / TiNet IPv6

- 1000 Mbit/s to NTT / TiNet
- Cisco ASR 1000 Router
- Brocade Load Balancers - IPv6 support was Beta
- DNS, Whois, IRR, more later
- Dual stack

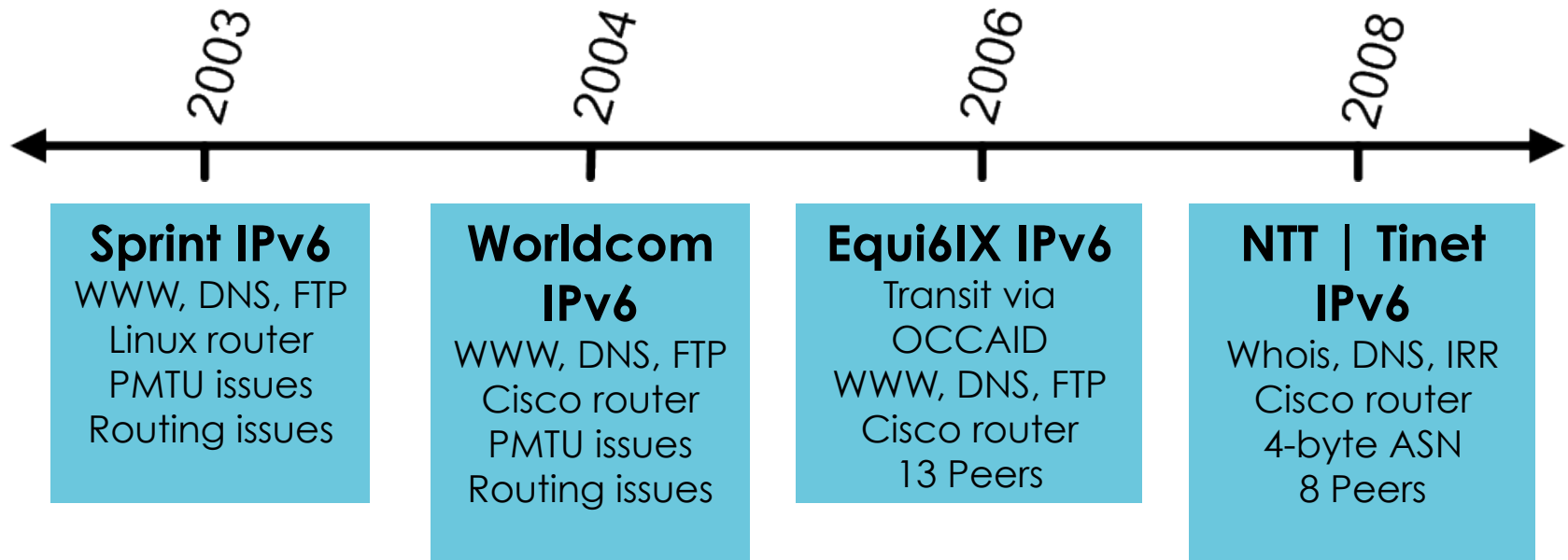


Past Meeting Networks

- IPv6 enabled since 2005
 - Tunnels to ARIN, others
- Testbed for transition technology
 - NAT-PT (Cisco, OSS)
 - CGN / NAT-lite
 - IVI
- Training opportunity
 - For staff & members



ARIN IPv6 Timeline



Internal Networks and Current Challenges

- Dual-Stacked Internally
 - Challenges over time with our VPN (OpenVPN)
 - One interface works with v6
 - One does not
- Middleware Boxes
 - Claims do not support reality (“we support IPv6”) Yes but..
 - No 1-1 feature set
 - Limits ARIN’s ability to support new services like https support for Whois-RWS

Questions?

