



# ARIN NANOG

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ON THE ROAD

Orlando, Florida

2/24/15

# Moving to IPv6

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Registry Knowledge

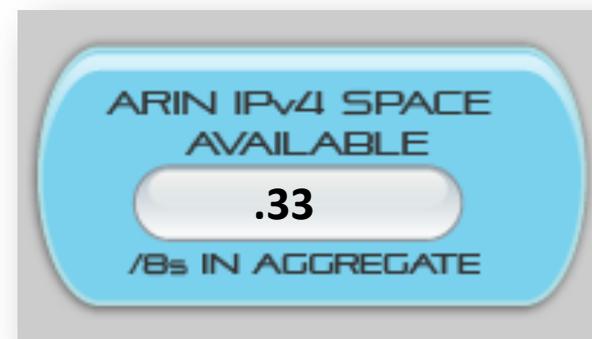
Mark Kusters, Chief Technology Officer

# 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

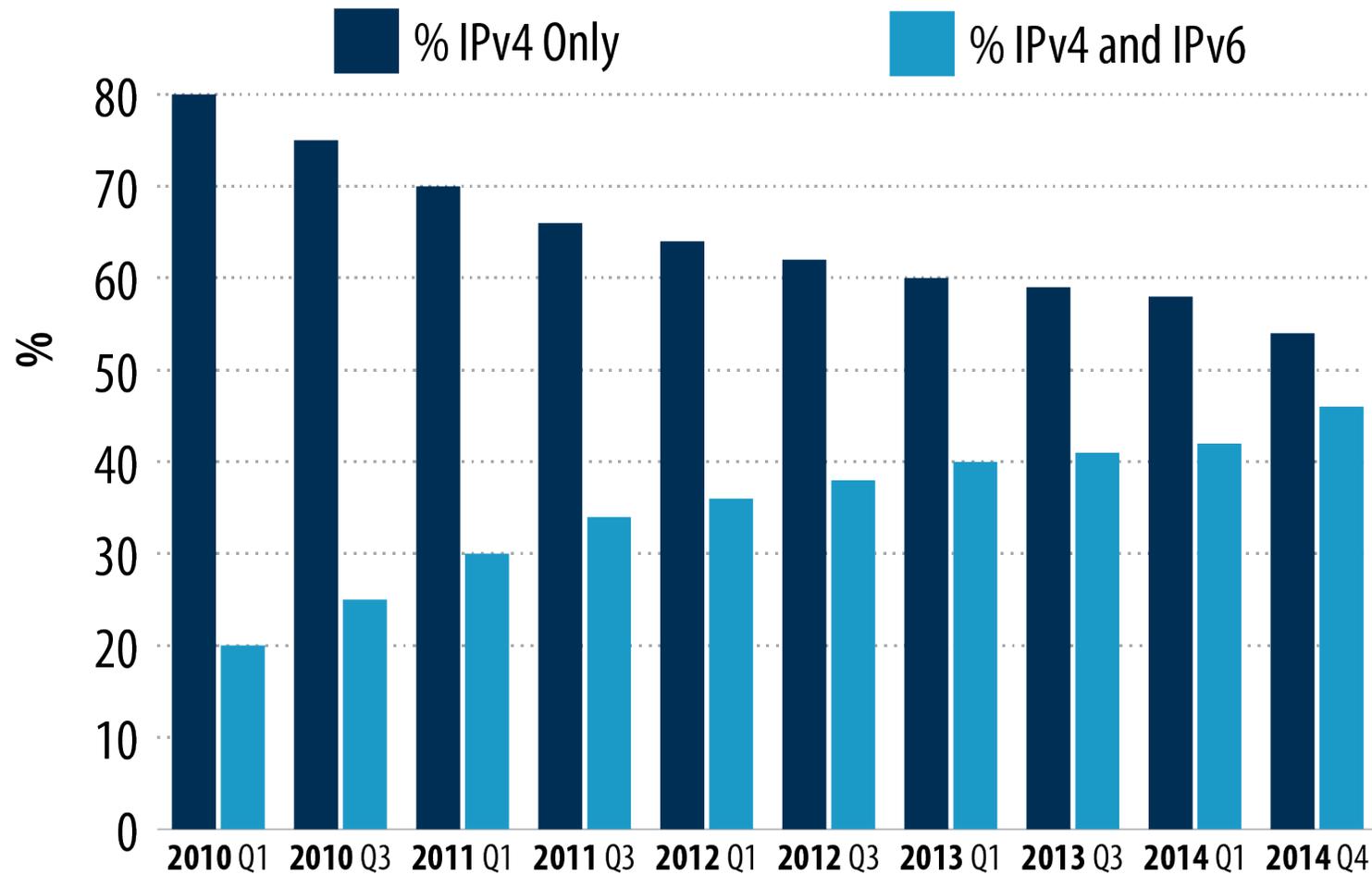
# Trends and Observations

- 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



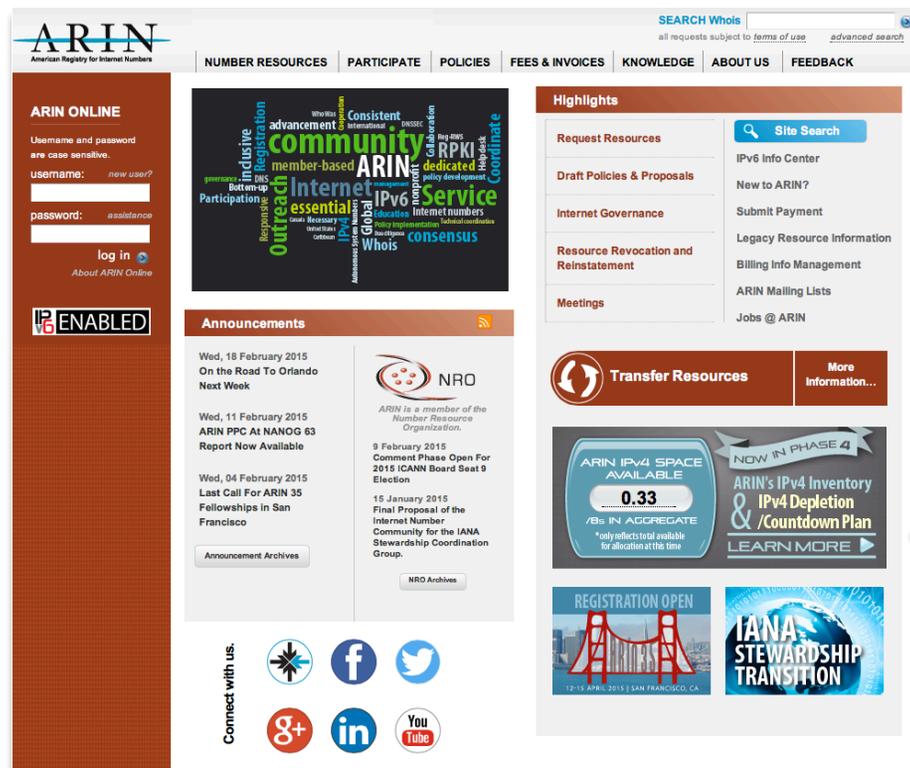
**4,960 subscriber members as of 13 February 2015**

## 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



The screenshot shows the ARIN website homepage. At the top, the ARIN logo is on the left, and a search bar is on the right. Below the logo is a navigation menu with links for NUMBER RESOURCES, PARTICIPATE, POLICIES, FEES & INVOICES, KNOWLEDGE, ABOUT US, and FEEDBACK. On the left side, there is a login section for ARIN ONLINE with fields for username and password, and a 'log in' button. Below that is an 'IPv6 ENABLED' badge. The main content area features a word cloud with terms like 'community', 'ARIN', 'Internet Service', and 'IPv6'. To the right of the word cloud is a 'Highlights' section with links to Request Resources, Draft Policies & Proposals, Internet Governance, Resource Revocation and Reinstatement, and Meetings. Below this is a 'Transfer Resources' section with a 'More Information...' link. The central focus is a large blue box titled 'ARIN IPv4 SPACE AVAILABLE' which displays '0.33 /8s IN AGGREGATE' and 'NOW IN PHASE 4'. To the right of this box is a 'Highlights' section with links to IPv6 Info Center, New to ARIN?, Submit Payment, Legacy Resource Information, Billing Info Management, ARIN Mailing Lists, and Jobs @ ARIN. Below the main content area is an 'Announcements' section with several news items dated from February 4 to February 18, 2015. At the bottom, there are social media icons for Facebook, Twitter, LinkedIn, YouTube, and Google+, along with a 'Connect with us.' label. A large blue arrow points from the right side of the slide towards the '0.33' figure in the IPv4 inventory box.

IPv4 inventory published on ARIN's website: [www.arin.net](http://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

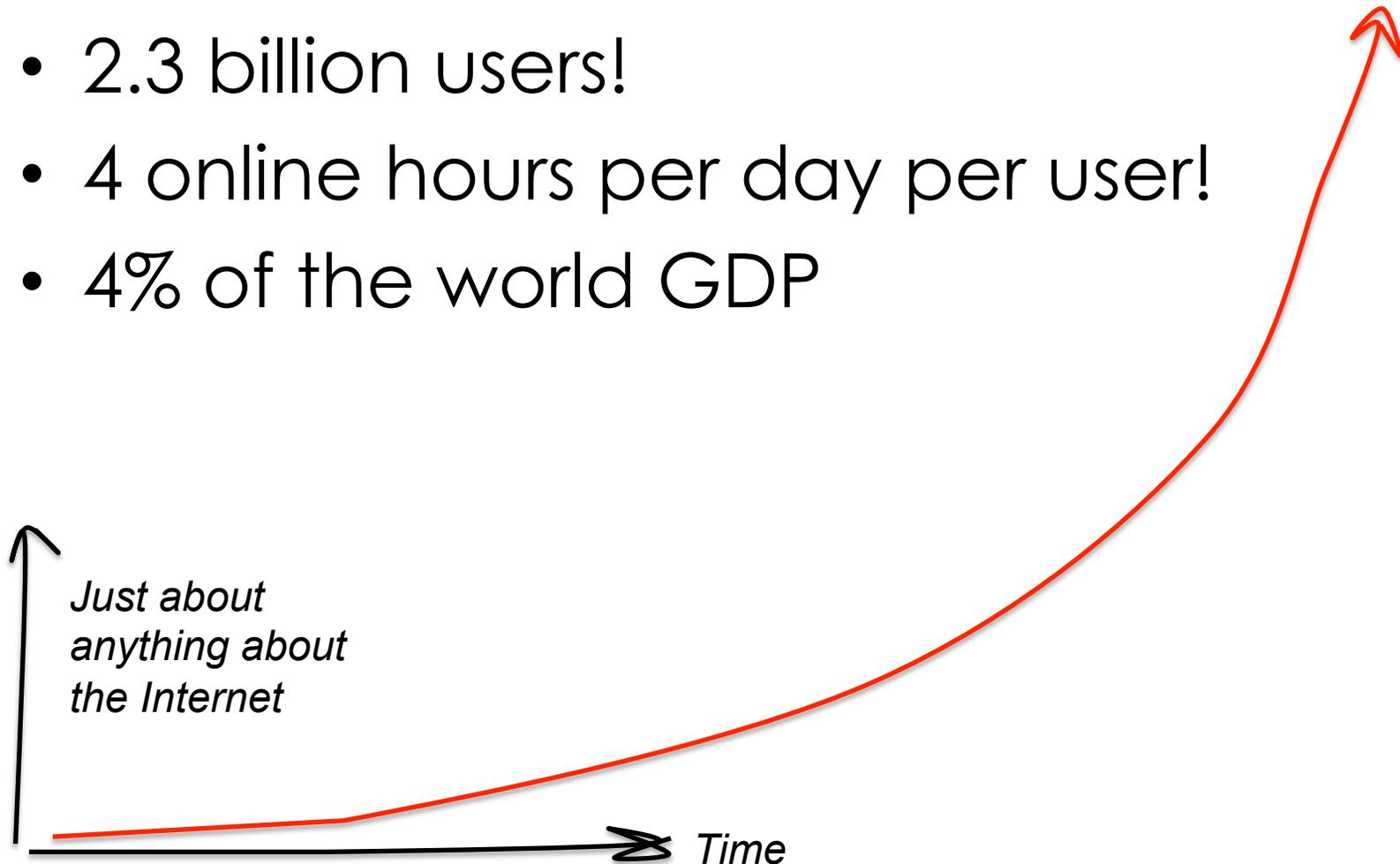
- Have a previous v4 allocation from ARIN **OR**
- Intend to multi-home **OR**
- Provide a technical justification which details at least 50 assignments made within 5 years

## 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

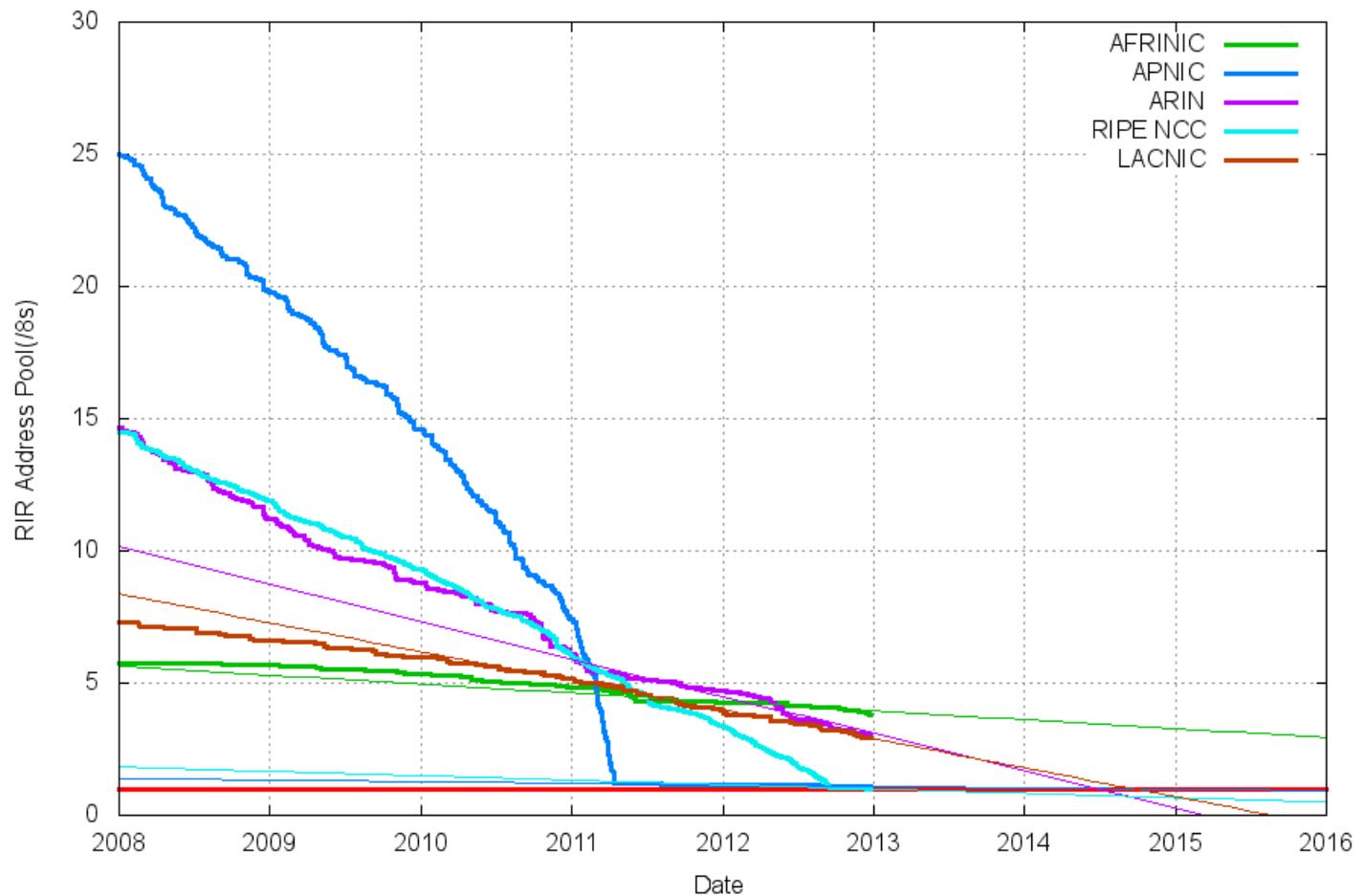
# The Amazing Success of the Internet

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

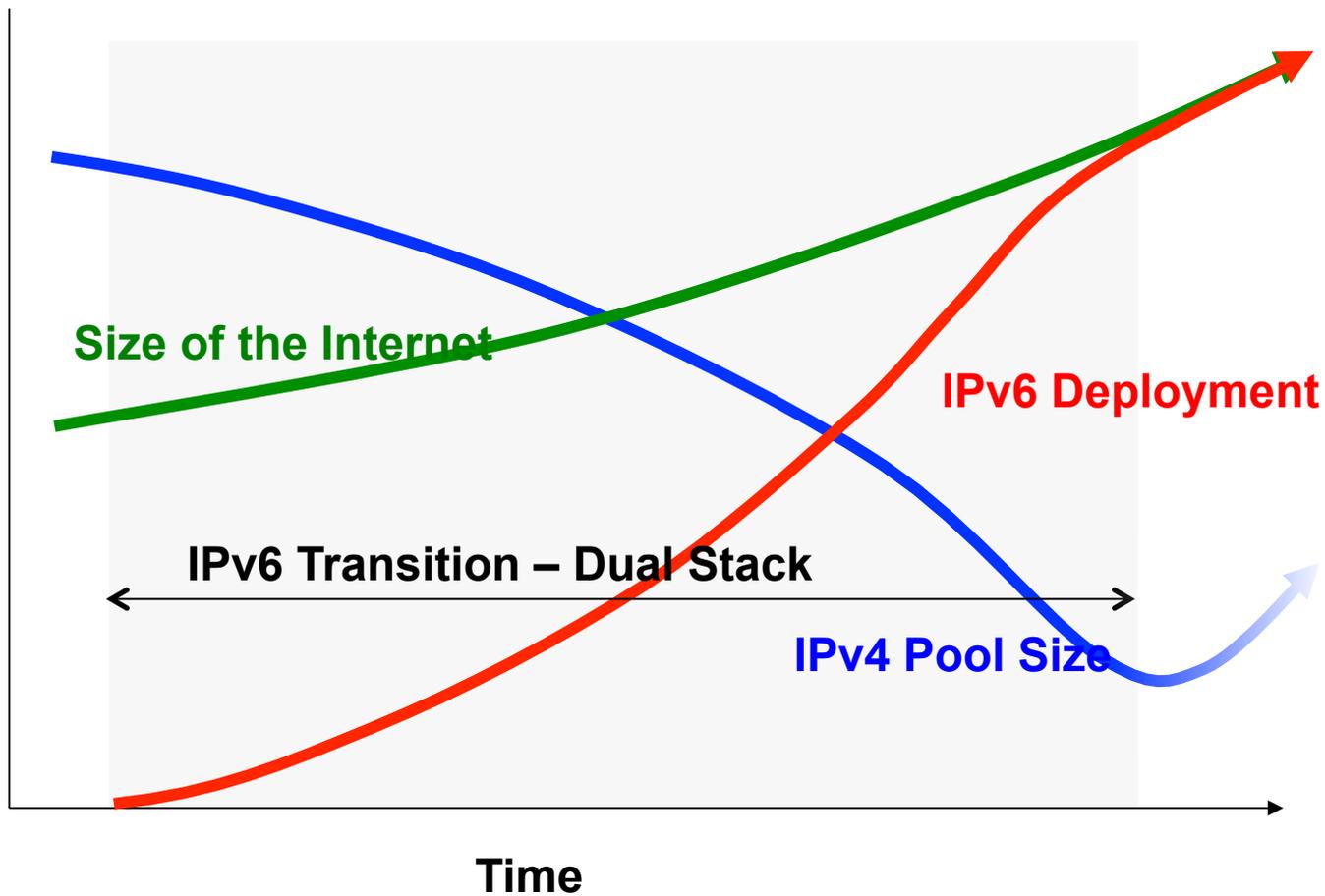


# Success-Disaster

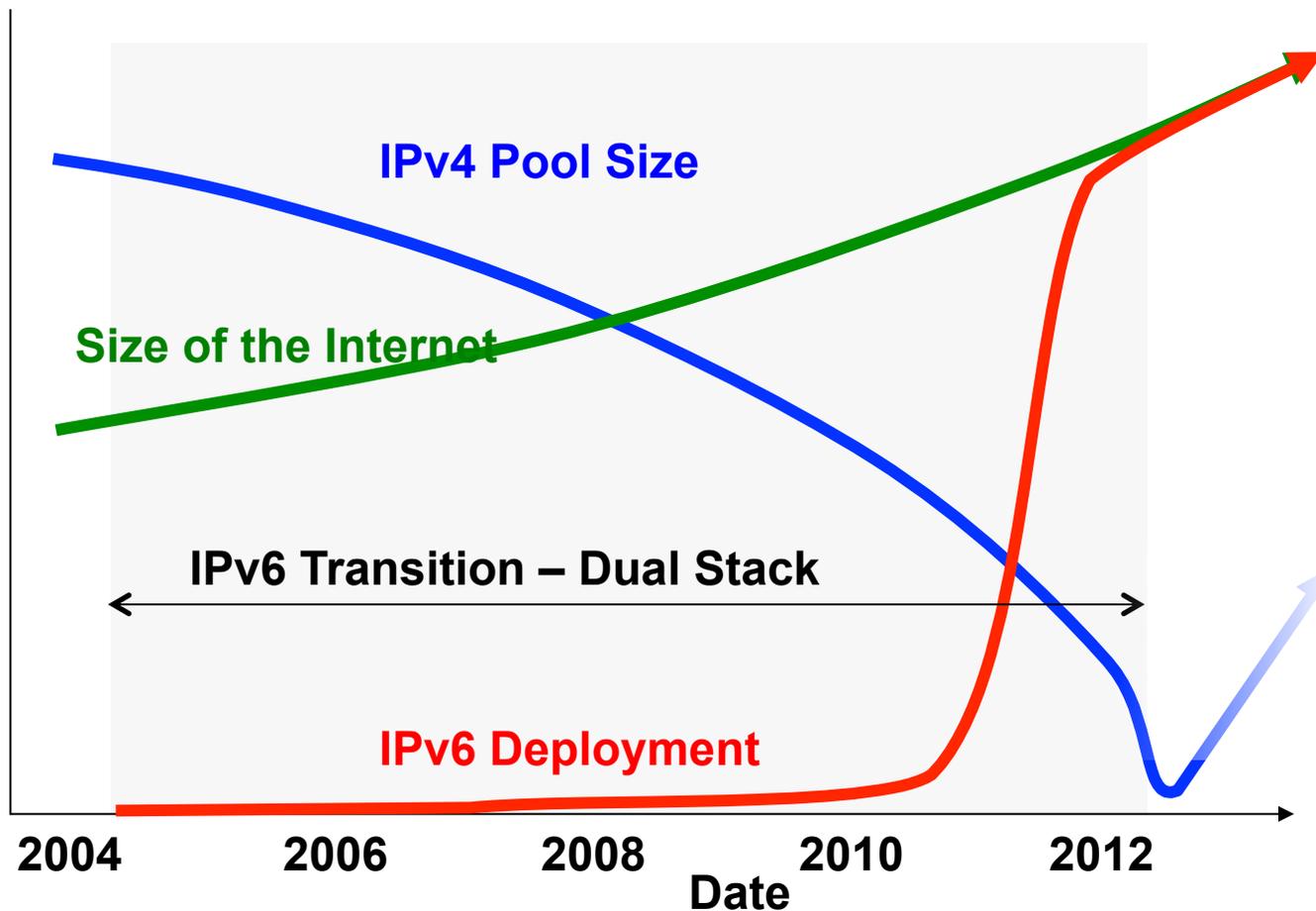
RIR IPv4 Address Run-Down Model



# The Original IPv6 Plan - 1995



# The Revised IPv6 Plan - 2005

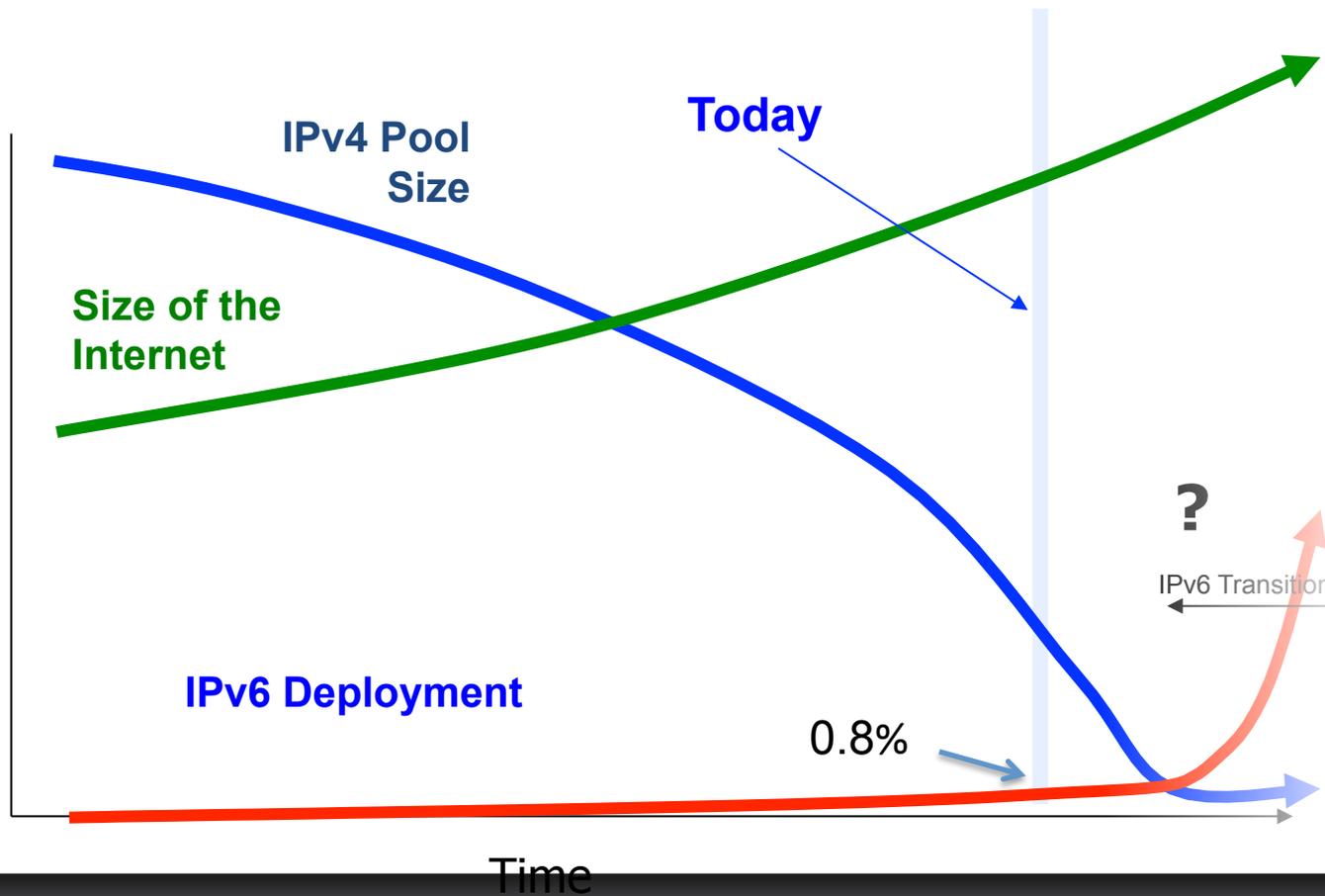


**Oops!**



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

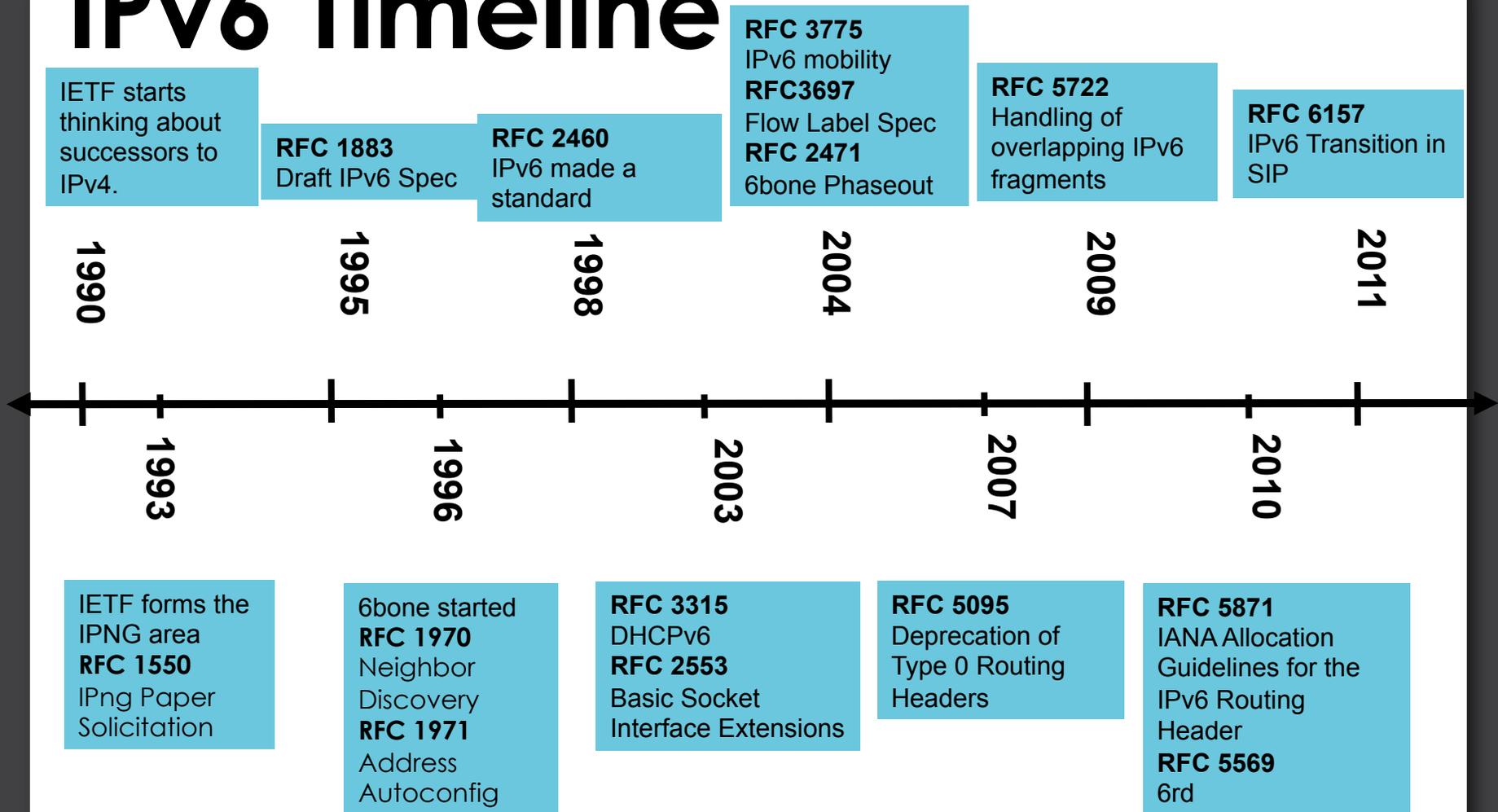
## What ARIN is hearing from the community

- 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

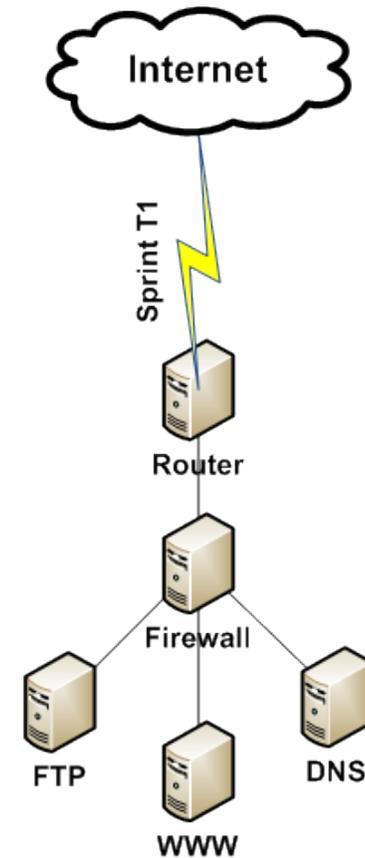
- IPv6 gives you better security – FALSE
- IPv6 gives you better routing – FALSE
- IPv6 has better applications – FALSE
- IPv6 is more flexible on network changes -  
MAYBE
  - RA vs DHCPv6
- IPv6 has more address bits – TRUE
- Therefore IPv6 is really IPv4 with more bits
- Requires effort to build deploy

# IPv6 Timeline



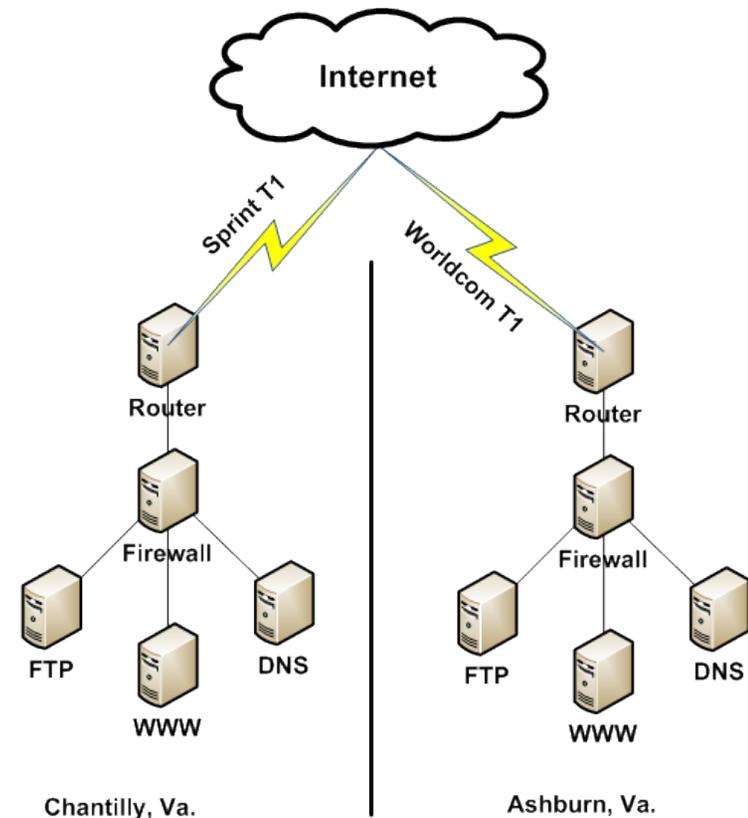
# 2003: Sprint

- 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



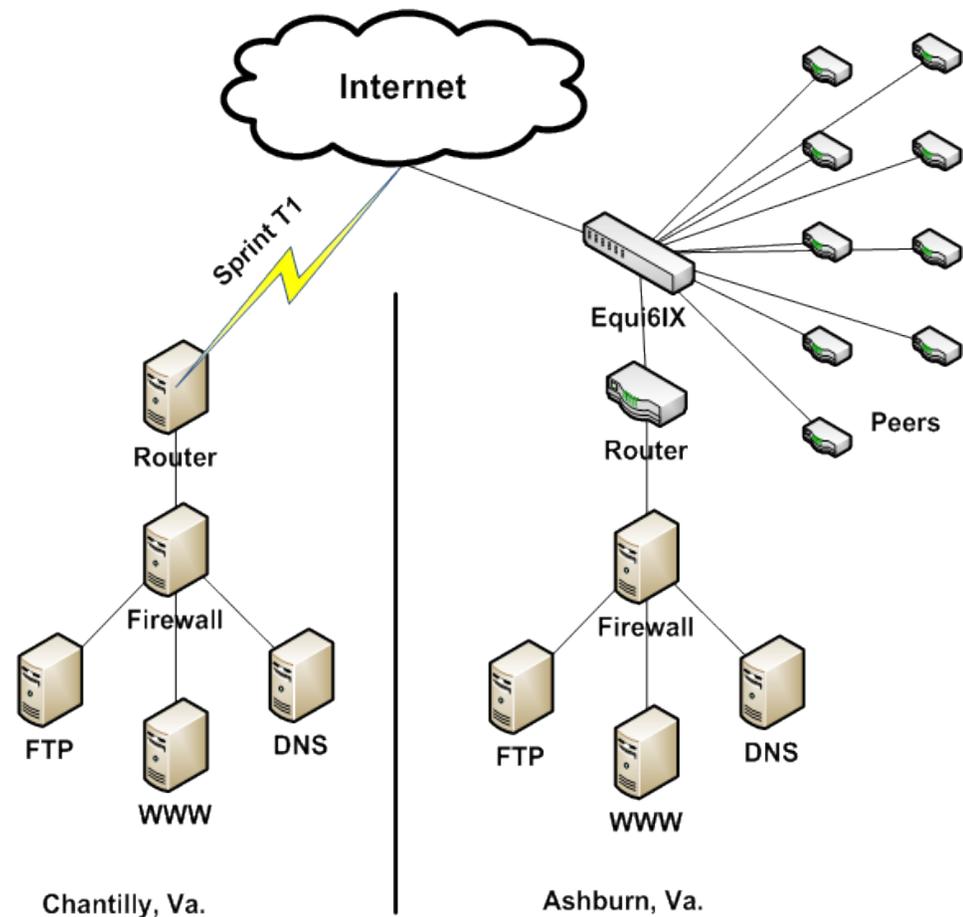
# 2004: Worldcom

- 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



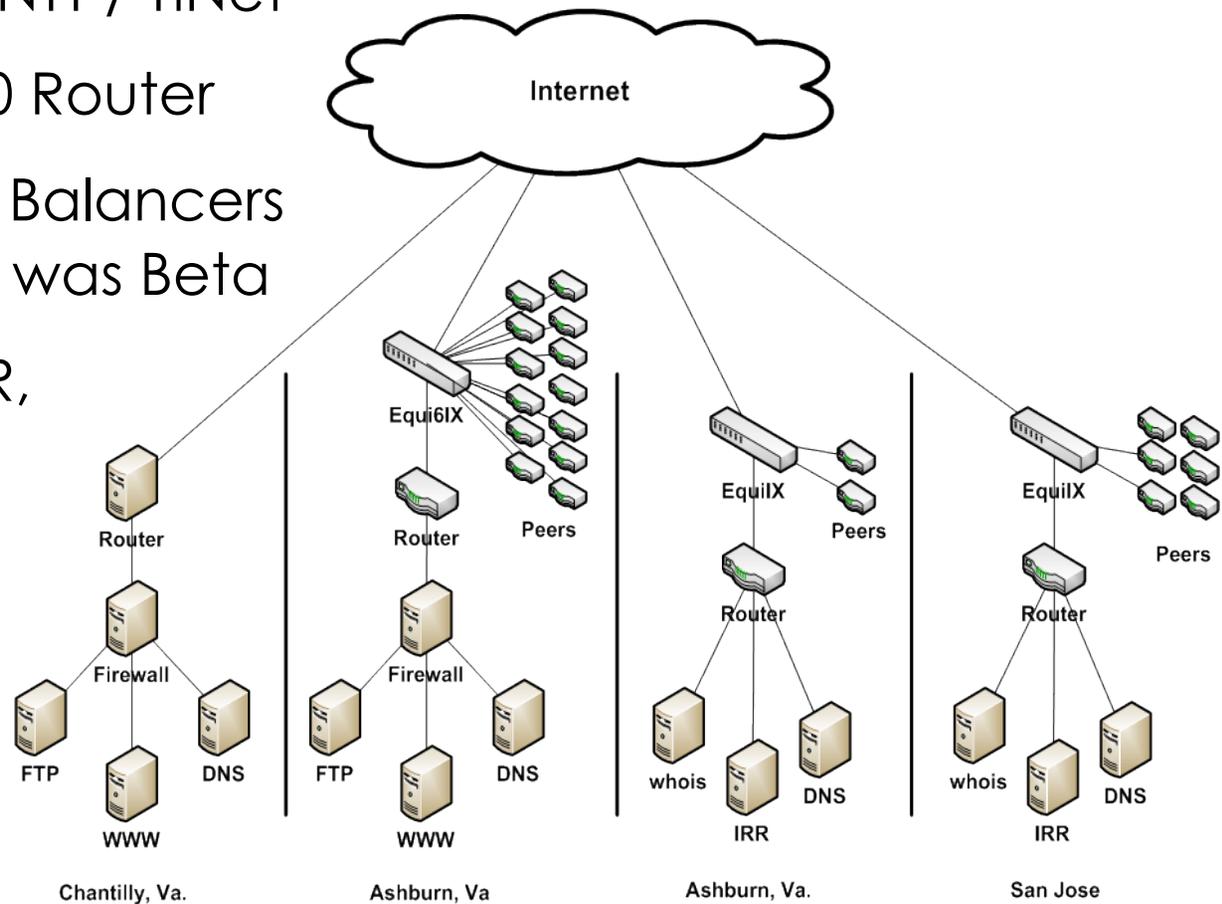
# 2006: Equi6IX

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



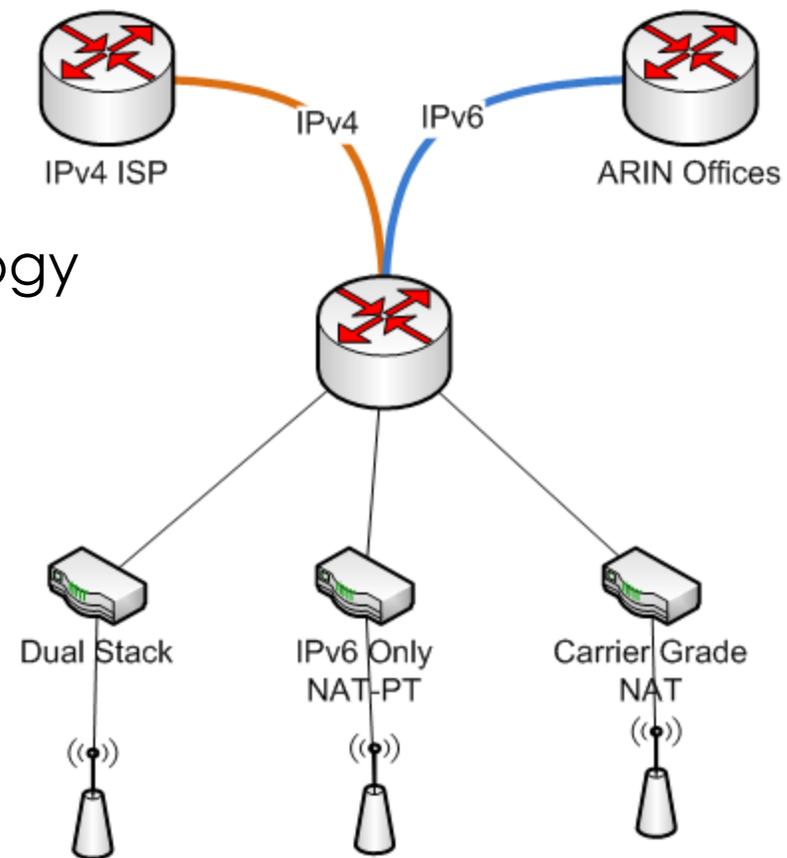
# 2008: NTT / TiNet IPv6

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

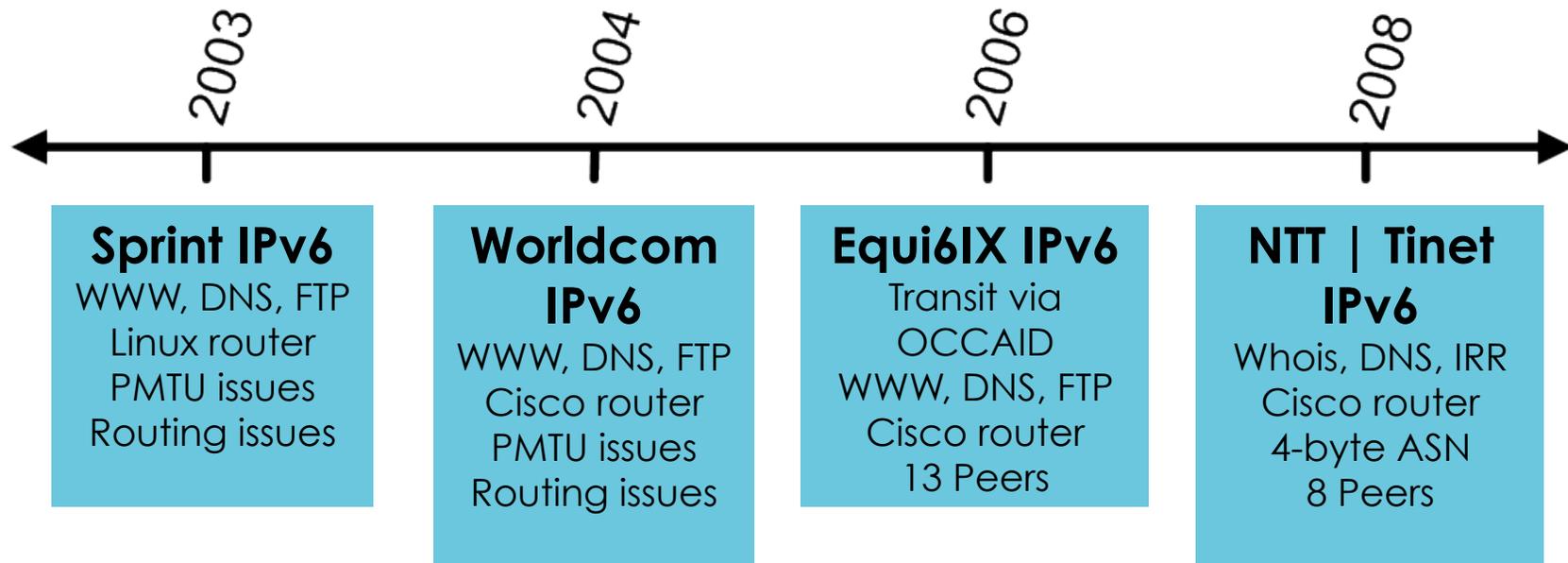


# Past Meeting Networks

- 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?

