Putting IPv6 to work

North American IPv6 Summit

Plaza Tower One Conference Facilities
Greenwood Village, CO
April 22-23, 2015

Rocky Mountain IPv6 Task Force

RMv6TF


ARIN
American Registry for Internet Numbers
State of IPv6
North American IPv6 Summit
April 2015
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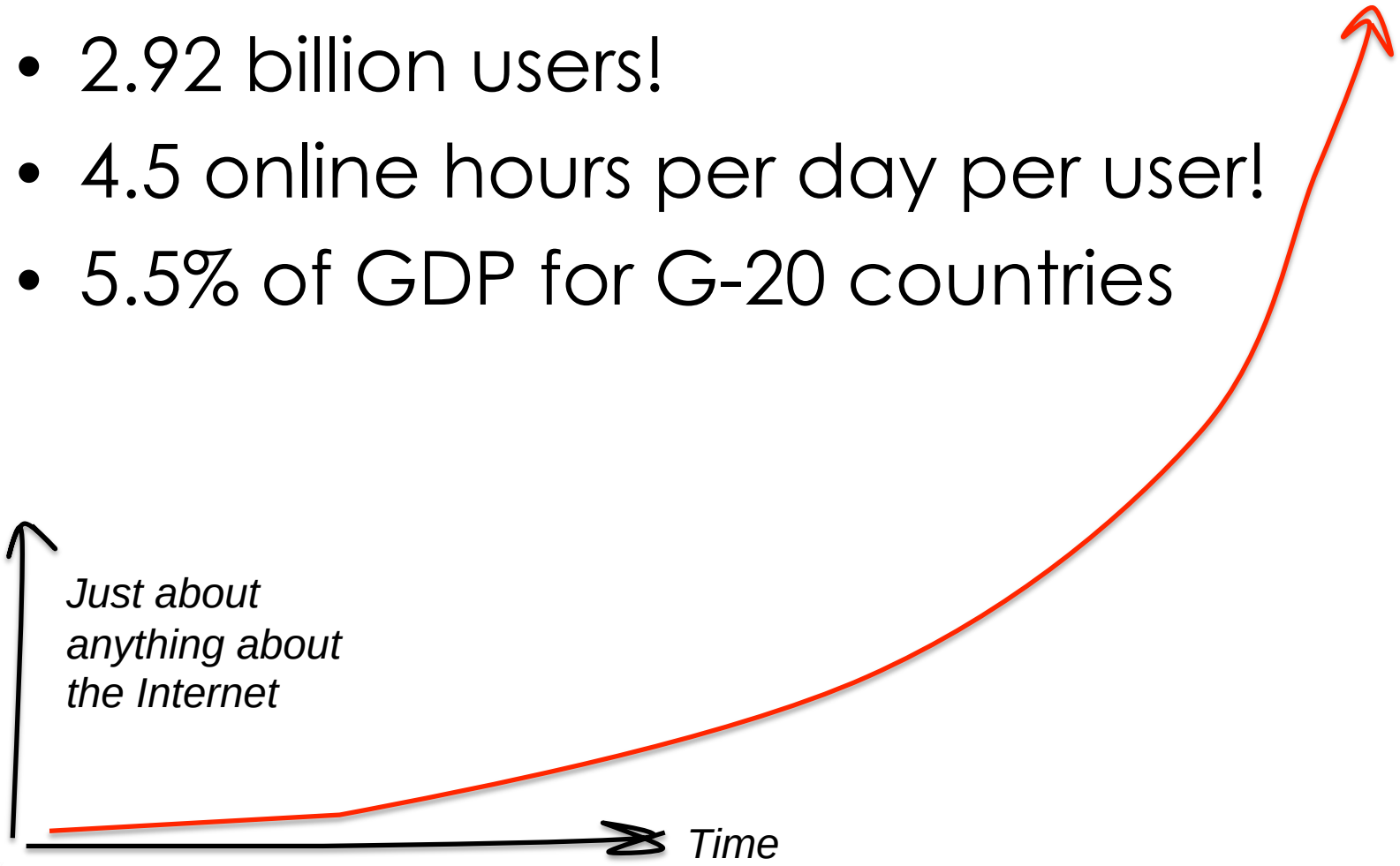
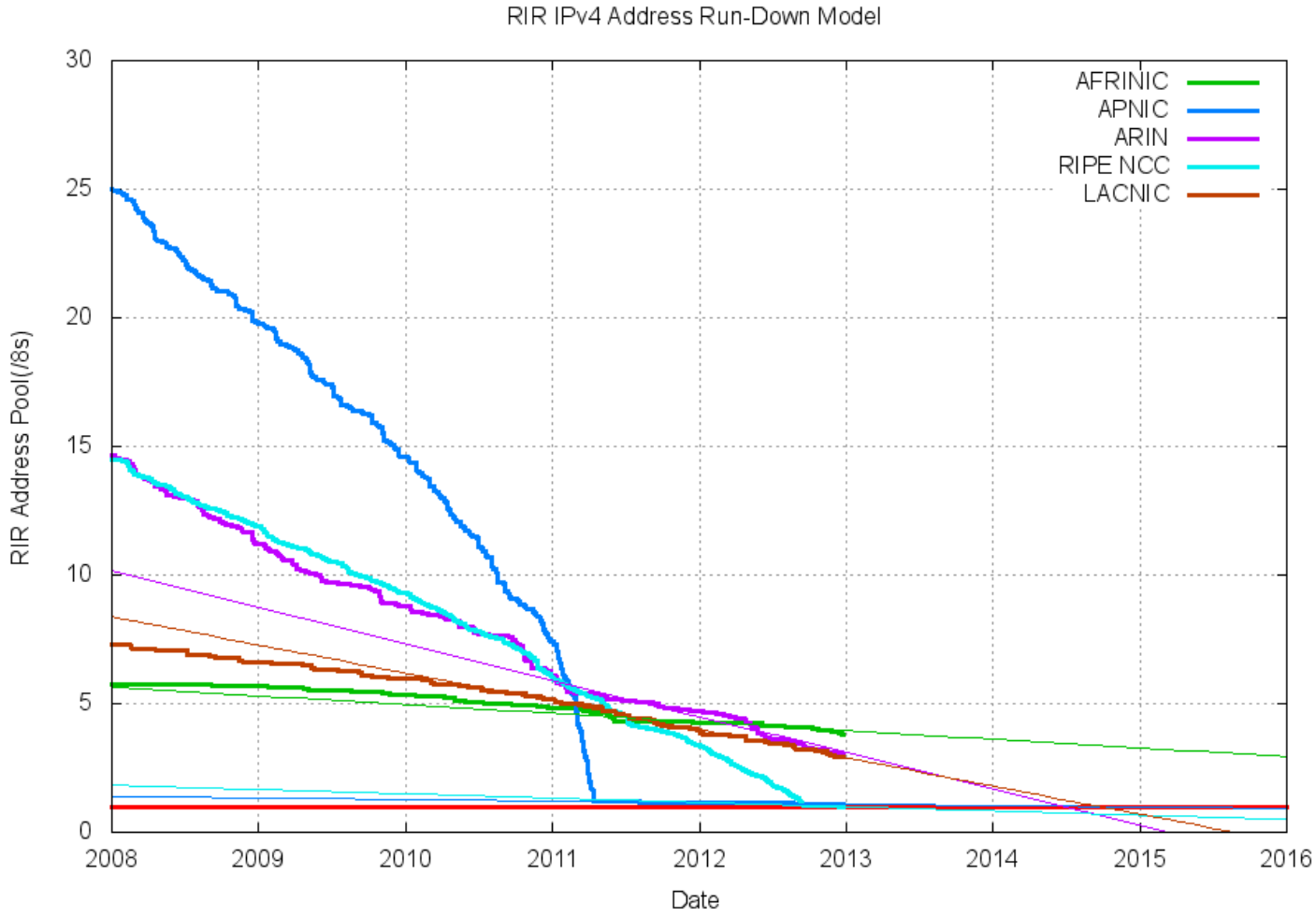
With some help from Geoff Huston

The Amazing Success of the Internet

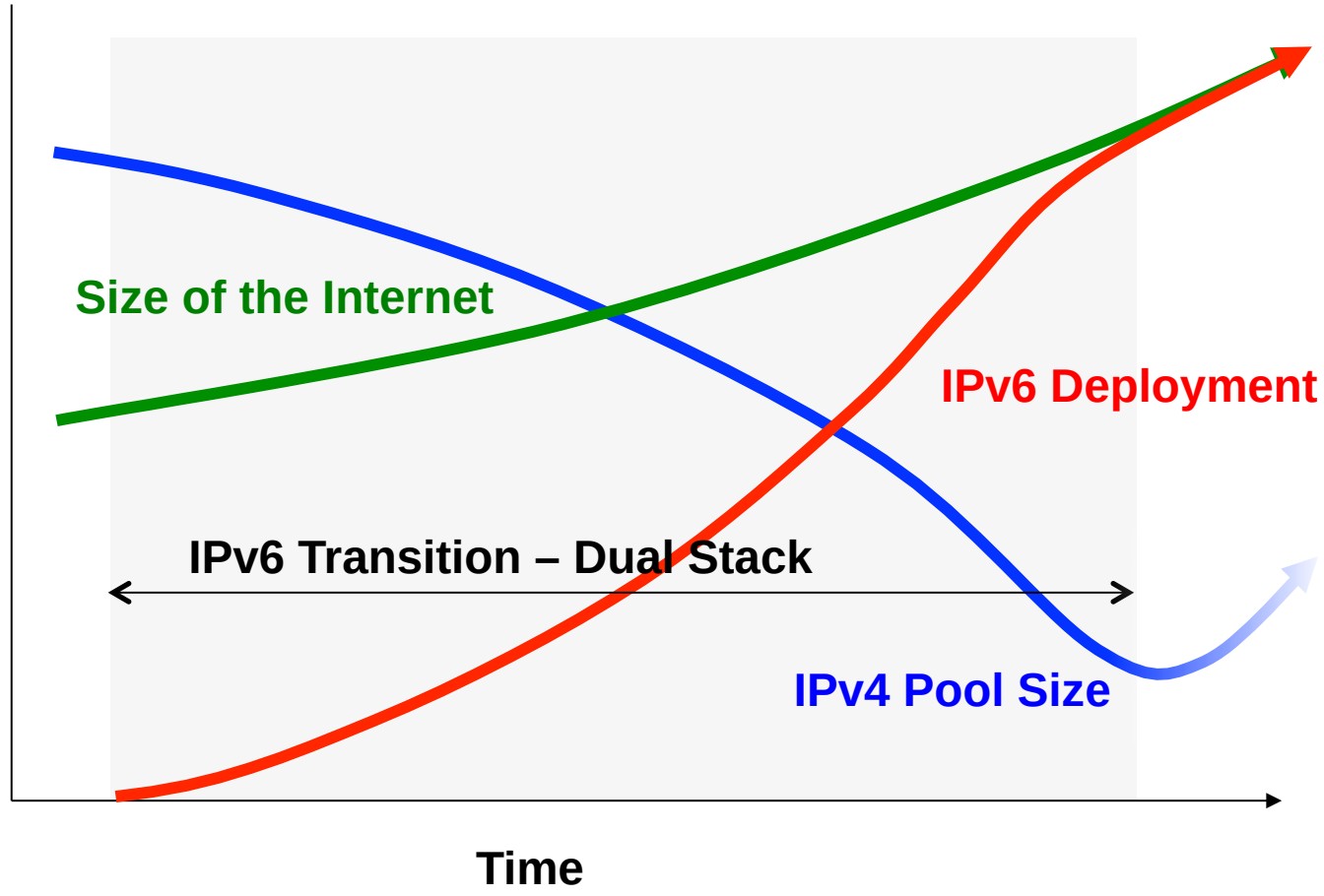
- 2.92 billion users!
- 4.5 online hours per day per user!
- 5.5% of GDP for G-20 countries



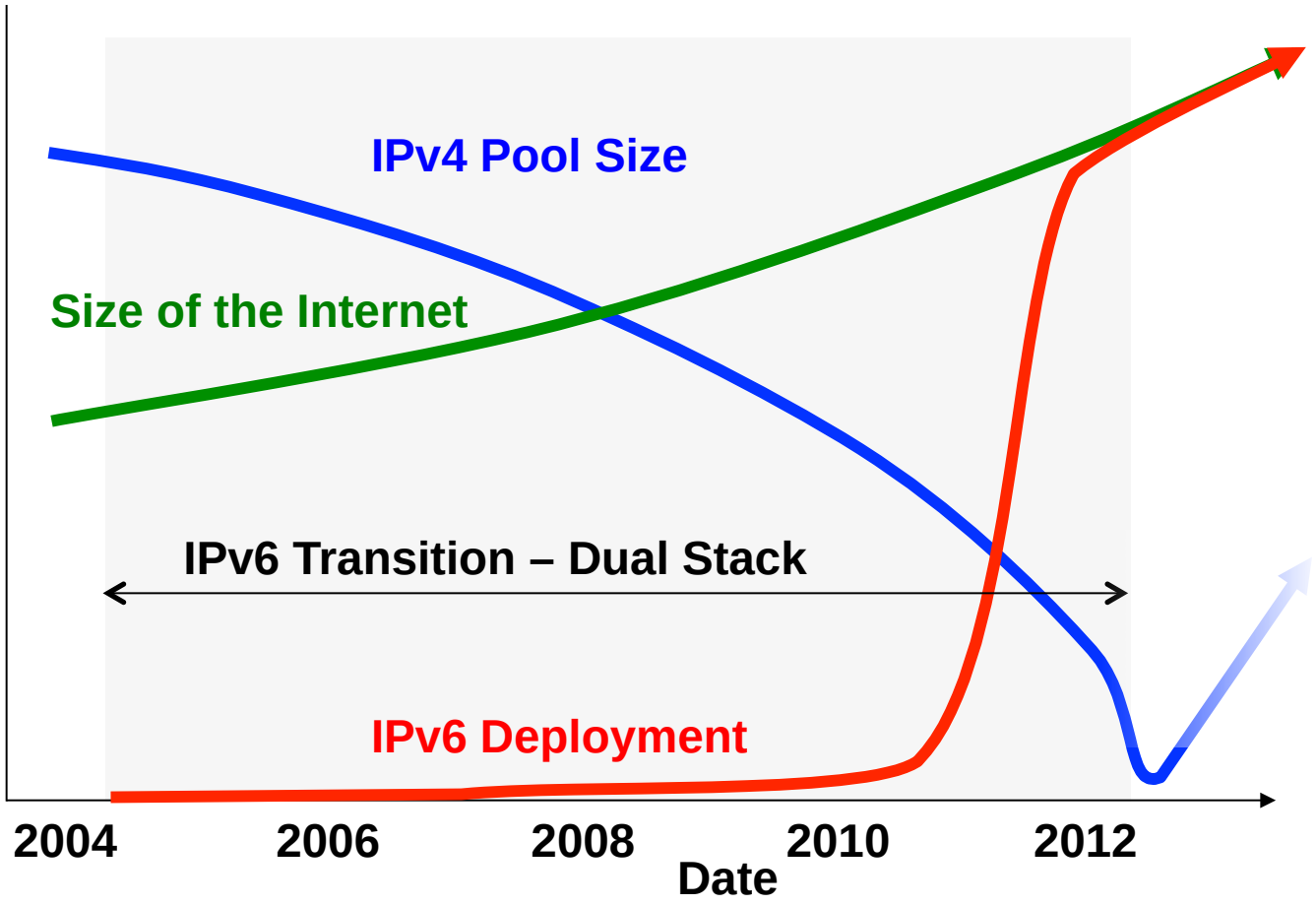
Success-Disaster



The Original IPv6 Plan - 1995



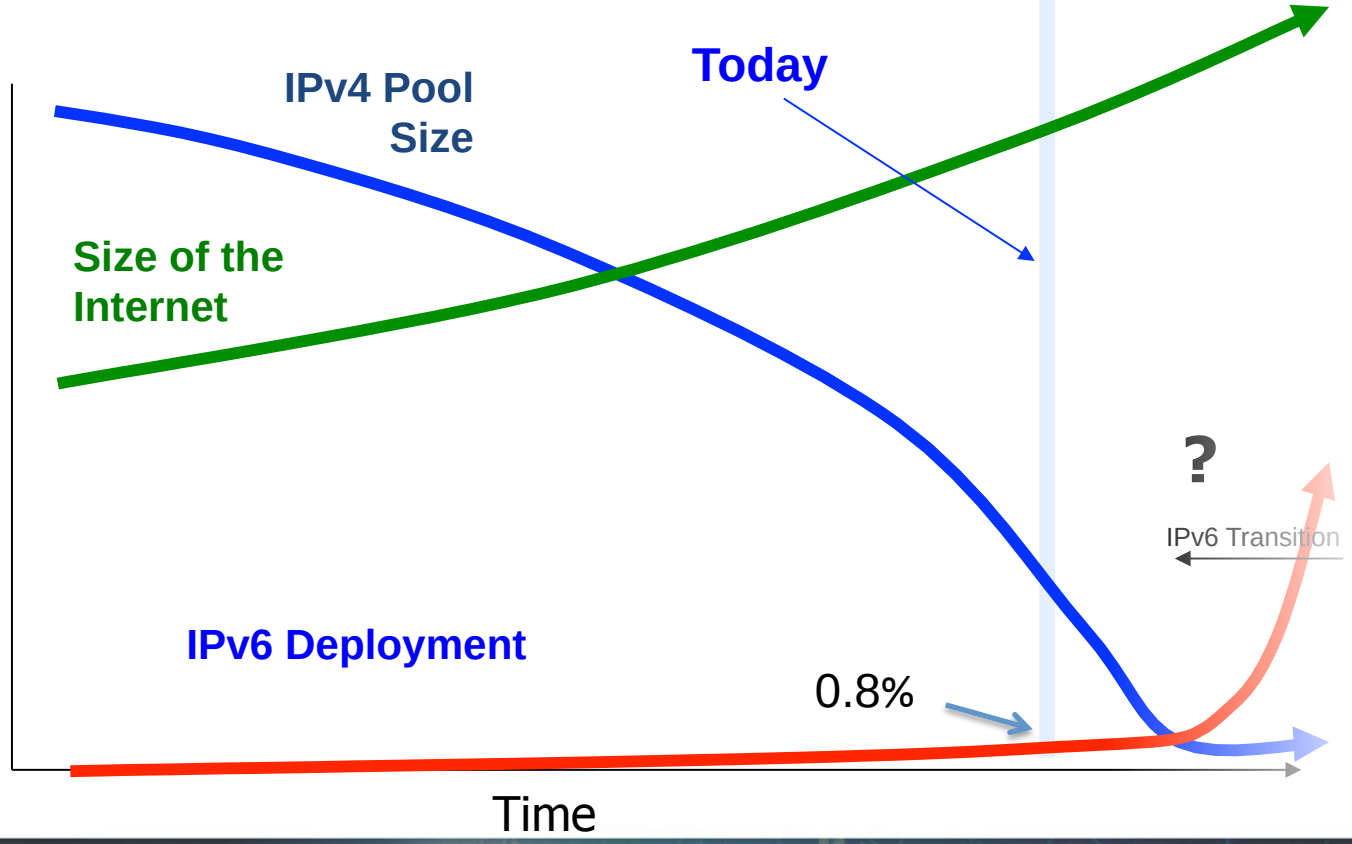
The Revised IPv6 Plan - 2005



Oops!

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

Today's Plan


IPv4 Pool Size
Today
Size of the Internet
?
IPv6 Transition
IPv6 Deployment
0.8%
Time

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 it's 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 containing firewall filters that block all forms of ICMP, 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 with 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, the industry is increasingly reliant on NATs:
  - Edge NATs are now the *de facto* choice for residential broadband services at the CPE
  - ISP NATs are now the *de facto* choice for 3G and 4G mobile IP services

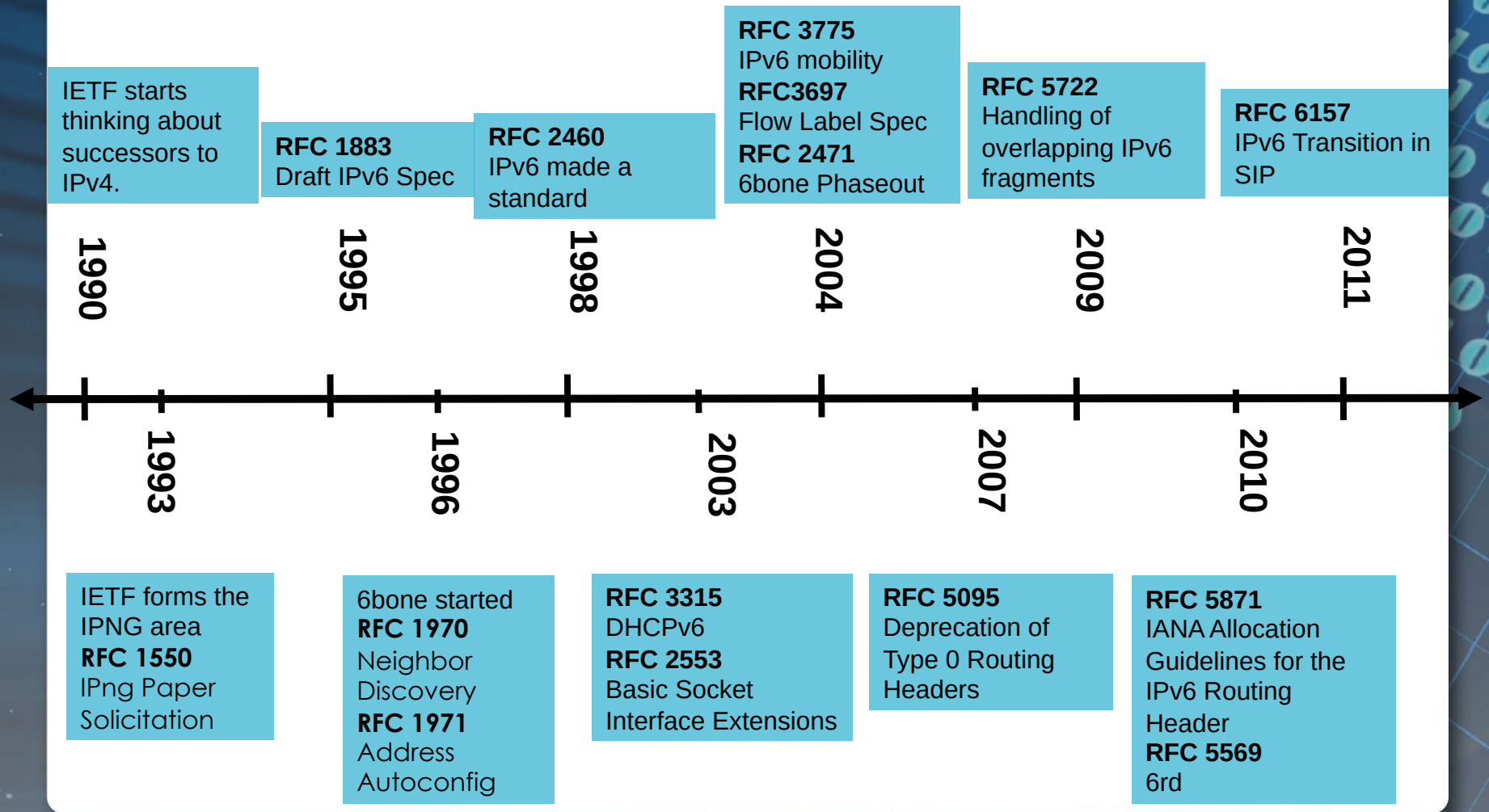
What ARIN is hearing from the community

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

Why is there little immediate need for IPv6?

- Some of the claims are either not true or taken over by events
  - IPv6 gives you better security
  - IPv6 gives you better routing
- Some positive things
  - IPv6 allows for end-to-end networking to occur again
  - IPv6 has more address bits
  - It is cheaper per address

IPv6 Timeline



ARIN IPv6 Timeline

Sprint IPv6
WWW, DNS, FTP
Linux router
PMTU issues
Routing issues

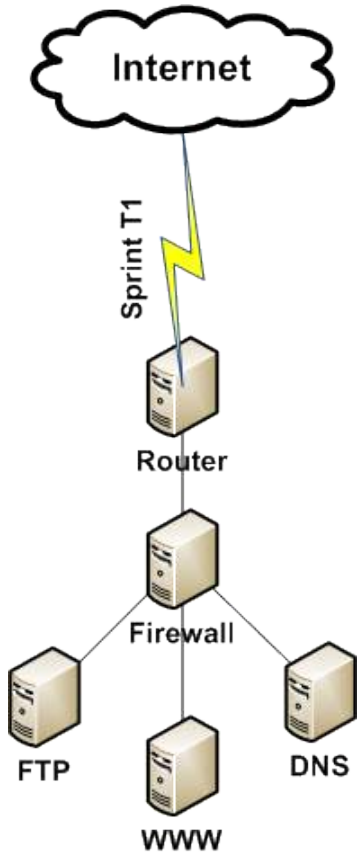
Worldcom IPv6
WWW, DNS, FTP
Cisco router
PMTU issues
Routing issues

Equi6IX IPv6
Transit via OCCAID
WWW, DNS, FTP
Cisco router
13 Peers

NTT | TiNet IPv6
Whois, DNS, IRR
Cisco router
4-byte ASN
8 Peers

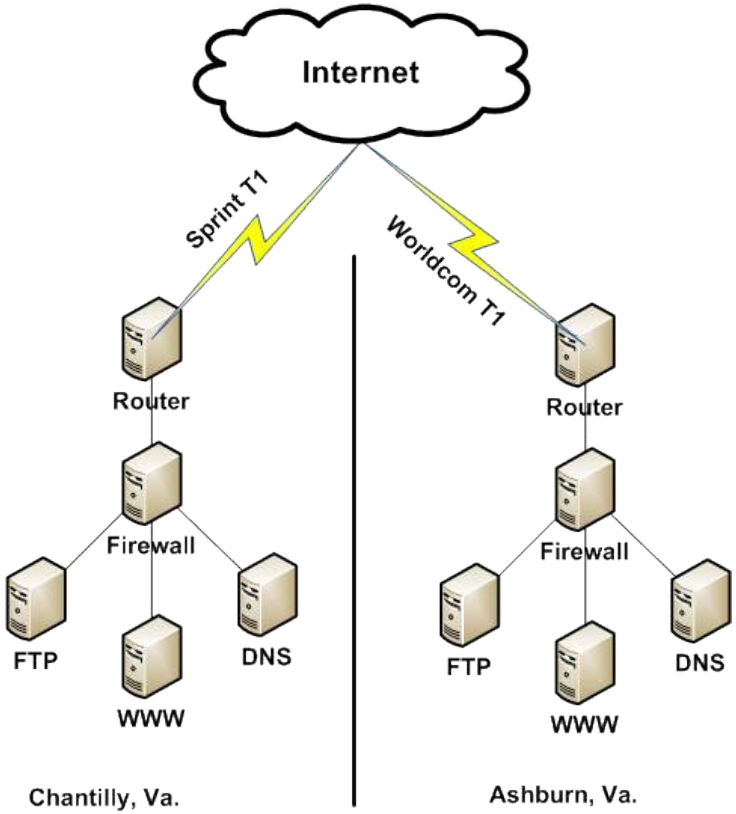
2003: Sprint

- 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



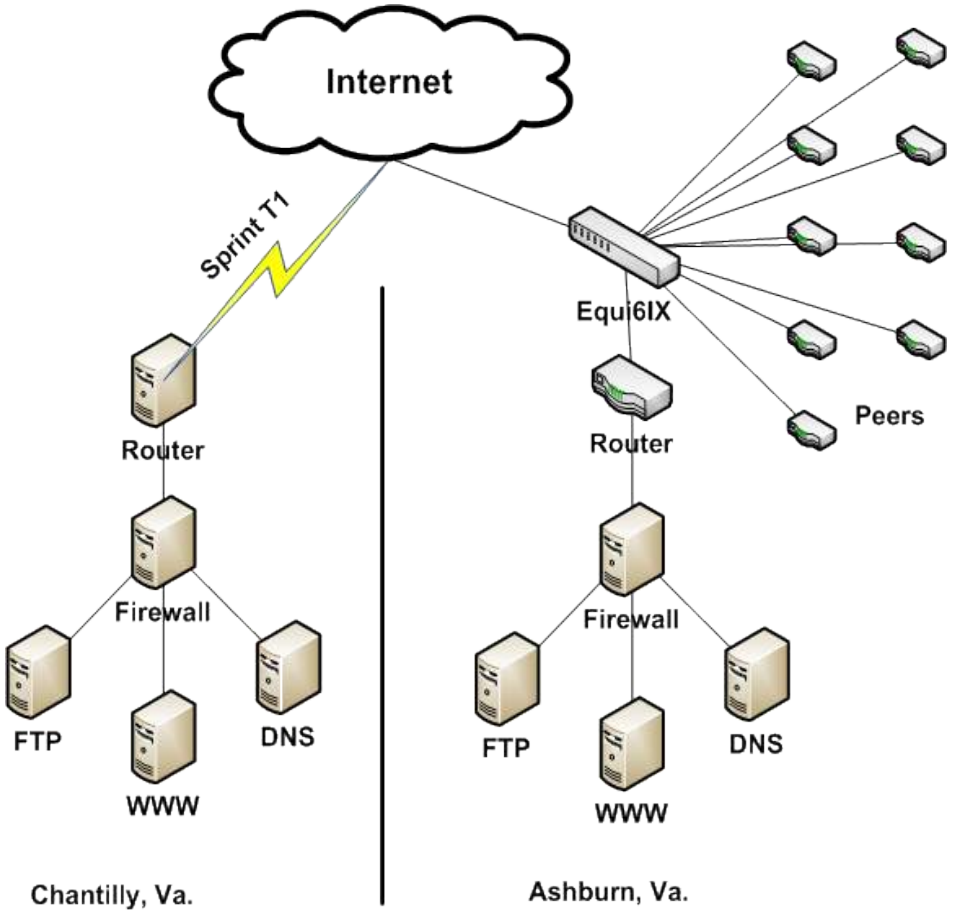
2004: Worldcom

- 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



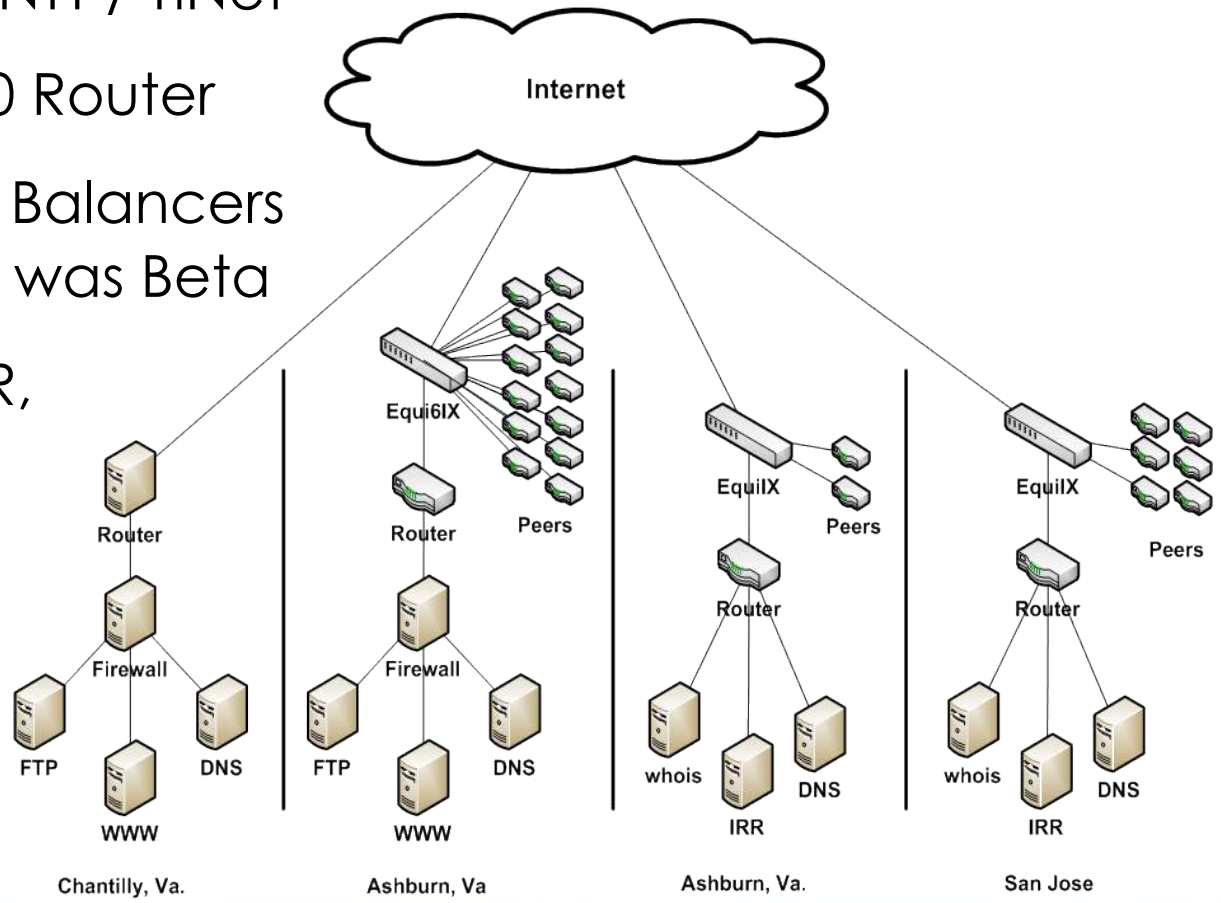
2006: Equi6IX

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



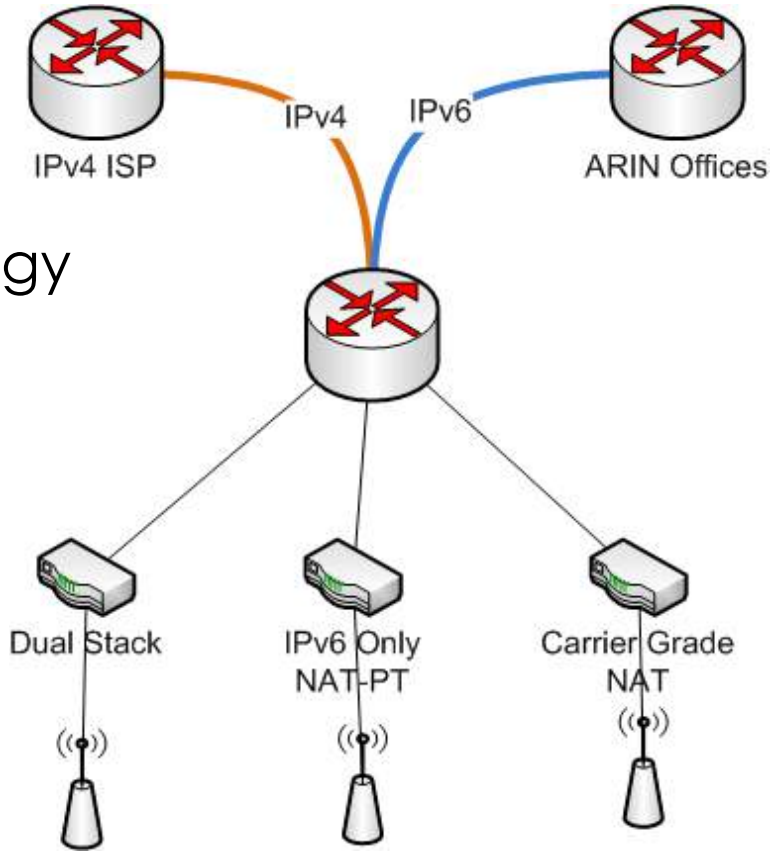
2008: NTT / TiNet IPv6

- 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 techology
  - NAT-PT (Cisco, OSS)
  - CGN / NAT-lite
  - IVI
- Training opportunity
  - For staff & members



ARIN's Current Challenges for Networking

- 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

So why do the move to IPv6?

- IPv4 will get more expensive
- Move to IPv6 will happen when cost is too high for IPv4
- Don't want to be caught with gear that will not support IPv6 before it is end-of-life
- Need to have some experience

Call to Action for IPv6

- ISPs should do it now
- Universities should be teaching and making IPv6 available
- Businesses should be asking for IPv6 support for gear and services they purchase
  - Want to be available to all on the Internet
  - If only IPv4 – may miss some IPv6 clientele
- Application developers need to integrate IPv6 support

Call to Action for IPv6

- End users
  - May be behind CGN
    - Impacts speed and services
    - Don't want to lose in those real-time games! (CoD gamers in particular)
  - Ask for IPv6 support
    - Faster
    - Better application support
    - Less support calls for IPv4

What is ARIN doing about it?

- What we see with Transfers based on market reality
- What we see with IPv6 Allocations

Current IPv4 Inventory

Available inventory:

.24 /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

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

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

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 requests 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

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

Types of Transfers

- NRPM = Number Resource Policy Manual
  - Drives ARIN's assignment and allocation policy
  - Community-directed effort
- Mergers and Acquisitions (NRPM 8.2)
- Transfers to Specified Recipients (NRPM 8.3)
- Inter-RIR transfers (NRPM 8.4)

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

Transfers to Specified Recipients (NRPM 8.3)

- Allows orgs with unused IPv4 resources to transfer them to orgs in need of IPv4 resources
- **Source**
  - Must be current registrant, no disputes
  - Not have received addresses from ARIN for 12 months prior
  - Ineligible for further addresses from ARIN for 12 months after
- **Recipient**
  - Must demonstrate need for 24-month supply under current ARIN policy

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

Reality Check

- Reports say current asking prices are around $10/IPv4 address
- Prices will likely rise once ARIN 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 – a few definitions

- Allocate – Intention to assign/allocate to others
- Assign – Resting spot for that IP space
- ISPs – ones who allocate to other ISPs or assign to end-users
- End Users –assigned to themselves

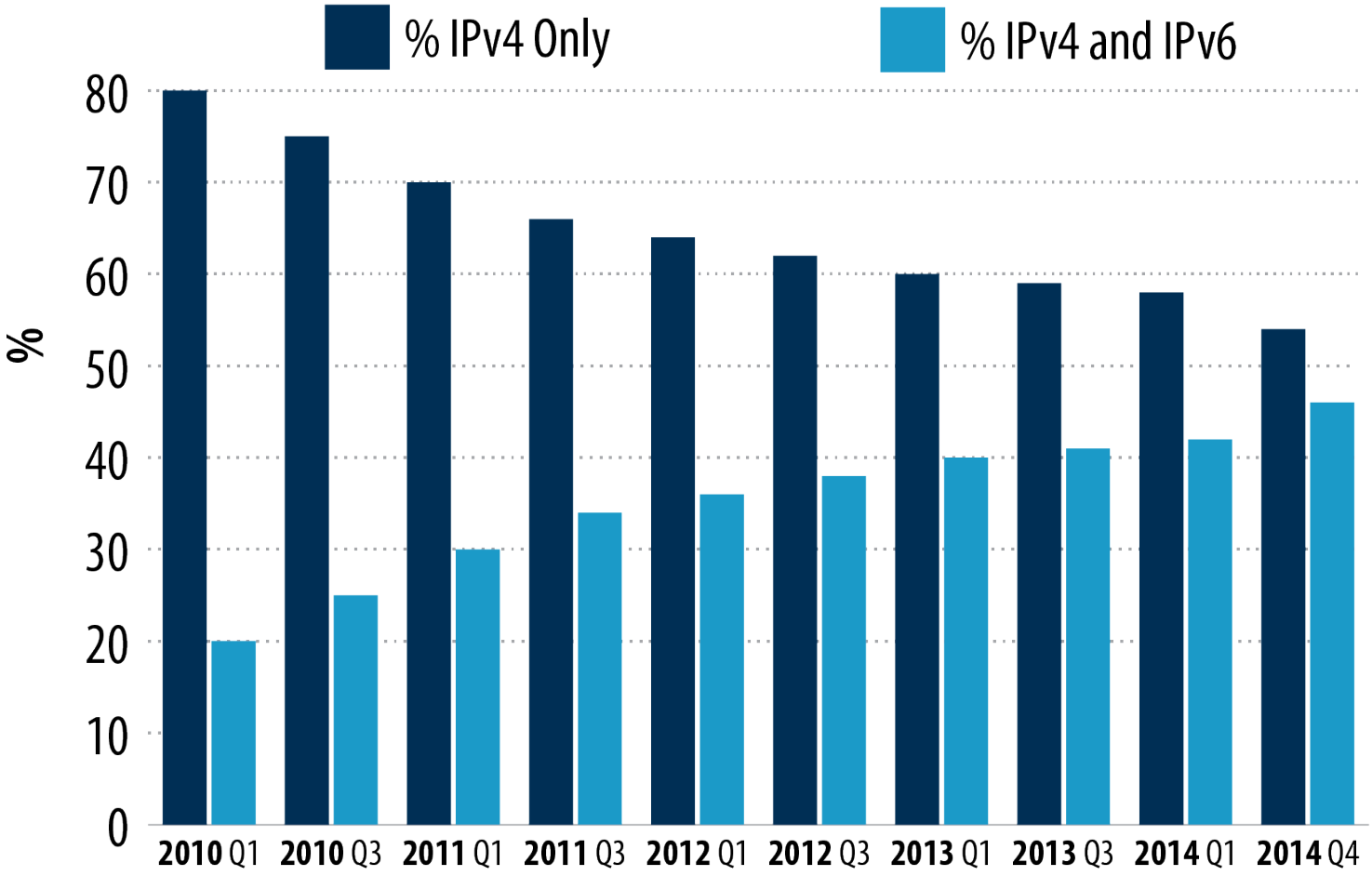
For ISPs, qualifying for IPv6 is easy!

- 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

For end-users, qualifying for IPv6 is also easy!

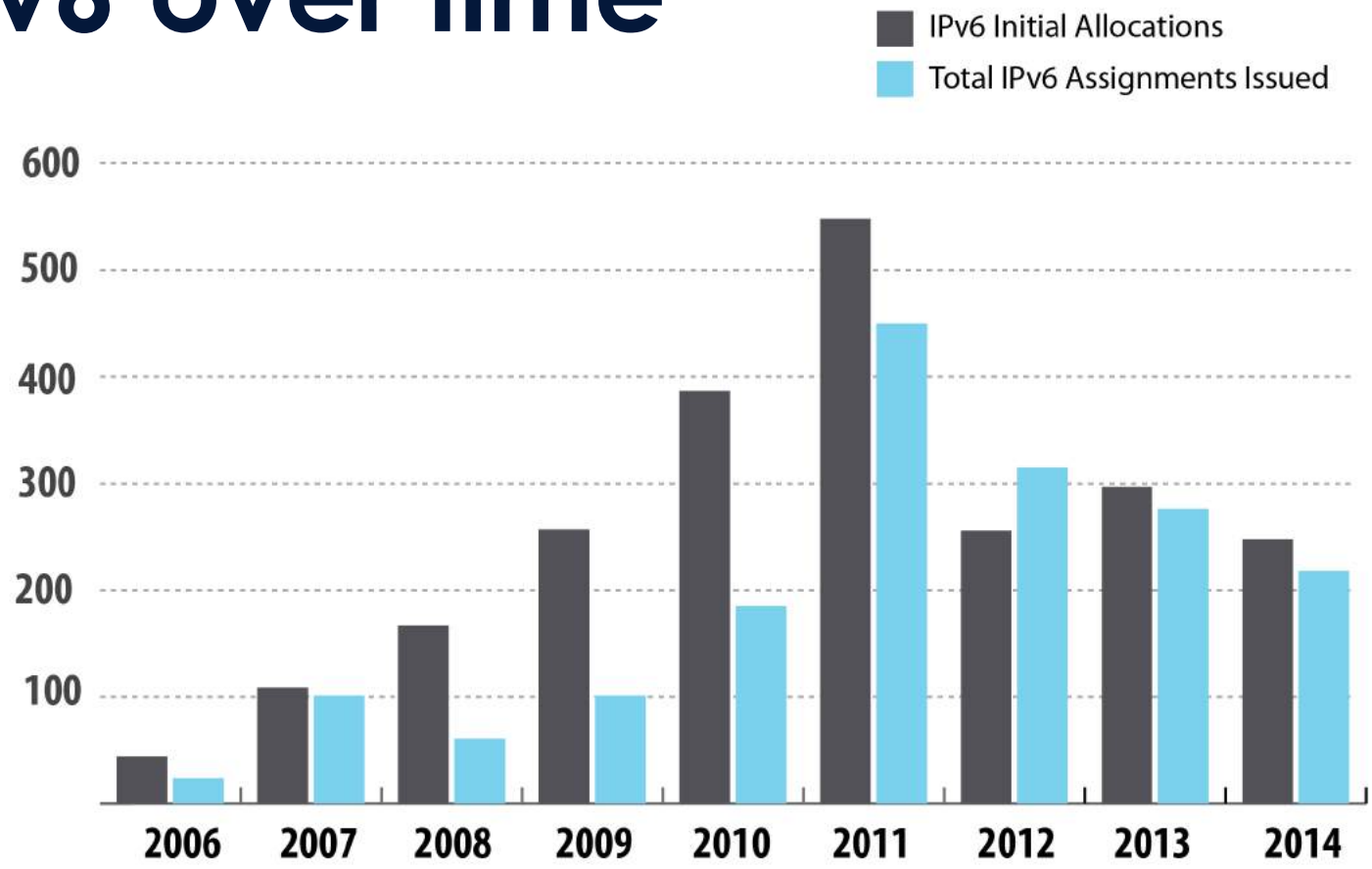
- Have a v4 direct assignment **OR**
- Intend to multi-home **OR**
- Show how you will use 2000 IPv6 addresses or 200 IPv6 subnets within a year **OR**
- Technical justification as to why provider-assigned IPs are unsuitable

ISP Members with IPv4 and IPv6



4,960 ISP members as of 13 February 2015

IPv6 over time



ARIN IPv6 Allocations and Assignments

Get IPv6 from ARIN now!

Most organizations with IPv4 can IPv6 without increasing their annual ARIN fees

Learn More

www.GetIPv6.info

IPv6 Info Center

www.arin.net/knowledge/ipv6_info_center.html

www.TeamARIN.net

Operational Guidance

www.InternetSociety.org/Deploy360/

www.NANOG.org/archives/

bcop.NANOG.org

www.hpc.mil/cms2/index.php/ipv6-knowledge-base-general-info

Questions?

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