ARIN 51 Keynote — Virginia Tech IPv6

The Next 25 Years

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25 Years of Production IPv6 at Virginia Tech

Things we learned that are still important

- We have definitely put time and effort into this, but it was nowhere close to the hardest and most labor-intensive things we have done.
- Many of the really difficult-to-deploy technologies are long gone. IPv6 is still here and still important.
- Making progress today is more about asking vendors the right questions and testing than obscure technical issues.

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IPv6 for Everyone

What you can do today #1 – Ask

Ask about IPv6 in your procurement process.

- The top vendor/provider excuse is still "*Nobody ever asked about it.*"
- Ask for a roadmap if not currently supported.

Mindset/Attitude

- IPv6 by default.
- Legacy IP is a liability: cost of addresses, complexity of networks (NAT, lack of transparency, reachability/duplication issues with RFC-1918, etc.)
- IPv6 really works today.

IPv6 for Everyone

What you can do today #2 – Test

- Claims and reality do not always 100% align.
- Maybe there has only been minimal IPv6 functionality testing on a dual-stack network.
- Goal: Make things work on an IPv6-only network.
  - installation
    management
    updates
  - support services: DNS, NTP, AAA

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IPv6 “Soft Start”

It’s not a flag day

- There isn’t a global “IPv6 switch” to flip on your network.
- Seeing IPv6 actually work on real networks is probably the best way to build confidence for larger deployment.
- DNS is key for services.
- Interface configuration is key for clients.

IPv6 “Soft Start”

Step 0 — Get a prefix and route it

- You’re going to need to get addresses and announce them to do anything.
- Core network routing is fairly easy once you get past the first few routers.
- Low risk for legacy IP routing — IPv6 configuration is generally independent.
- Enable on engineering/support user networks first.

IPv6 "Soft Start"

DNS is key for services

- Enabling IPv6 connectivity on a server host is fairly low risk. In many cases, it is already enabled.
- Make sure services bind to the correct IPv6 address.
- Add a test name service.ipv6.example.com with AAAA.
  - Don't forget TLS certificate Subject Alternative Name if you care about that.
- Go production
  - Add AAAA record to existing A record for service.example.com. Consider short TTL if you are worried.
- Useful for testing service.ipv6.example.org AAAA only
  service.ipv4.example.org A only

IPv6 “Soft Start”

Interface configuration is key for clients

- A user network is not using (your) IPv6 until you configure an address on the interface and start sending RAs (router advertisements).
- RA options allow setting prefix lifetime if you are really worried.
- Our experience has been that if IPv6 connectivity exists there are few problems when enabling IPv6 on a user network.

IPv6 “Soft Start”

Happy Eyeballs

- Reduces risk of enabling IPv6.
- Attempts legacy IP and IPv6 connections at the same time.
- No wait for timeout and fallback.
- Baked into browsers for a decade.
- Key technology that enabled World IPv6 Launch.

IPv6 Barriers

Eric Brown, Senior Network Architect, Virginia Tech

Many organizations still need to adopt IPv6

- Full adoption may be a certainty, but a soft landing isn't
- Where are the barriers to adoptions?
- What is causing the friction?

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Friction: Perverse Economics

- IP addresses should NOT cost money
  - administrative costs aside
- The transfer market creates incentive structures that resist the change to IPv6

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Friction: Reachability

- Not all large transit providers carry a full routing table
- This creates the perception that IPv6 is not ready for primetime
- Distrust among users worried about possible traffic turbulence
  - https://www.theregister.com/2018/08/28/ipv6_peering_squabbles/
  - https://adminhacks.com/broken-IPv6.html
  - https://www.reddit.com/r/networking/comments/k9ohok/cogentgoogle_dispute_is_google_withholding_v6/
- **Stop weaponizing reachability**

Photo credit: Owen DeLong

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Friction: Internet Service Providers

- IPv6 not available everywhere
- IPv6 available for residential but not business
- Users should receive a stable IPv6 prefix delegation

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Friction: Application Service Providers

- Don’t make your customers ask to have IPv6 turned on
- Make support of IPv6 de rigueur and advertise it
- Baby steps: make sure your application works with NAT64

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Friction: Network Equipment and Services

- IPv6 parody is almost not a joke anymore! Good job
- Eat your own dog food
  - Silly problems still aren't being caught
- Assume IPv6 is business critical for your customer
  - If your website is not IPv6 reachable then it implies IPv6 is not business critical for you

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Friction: Software

- Consider the full product lifecycle when supporting IPv6
  - Installation
  - Registration
  - Use
  - Updating

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Friction: Users

- Don’t view problems as an excuse to avoid change
  - Seek out solutions
- Just turn it on
- Demand support
- The small end user has the most to lose when legacy availability gets worse

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Friction: Education

- Teach networking using IPv6 as your example

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Legacy sunset

- Our biggest hurdle to IPv6 adoption is the will to do it
  - While there are still technical issues, none are unsolvable
- **Here's to a soft landing!**

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