

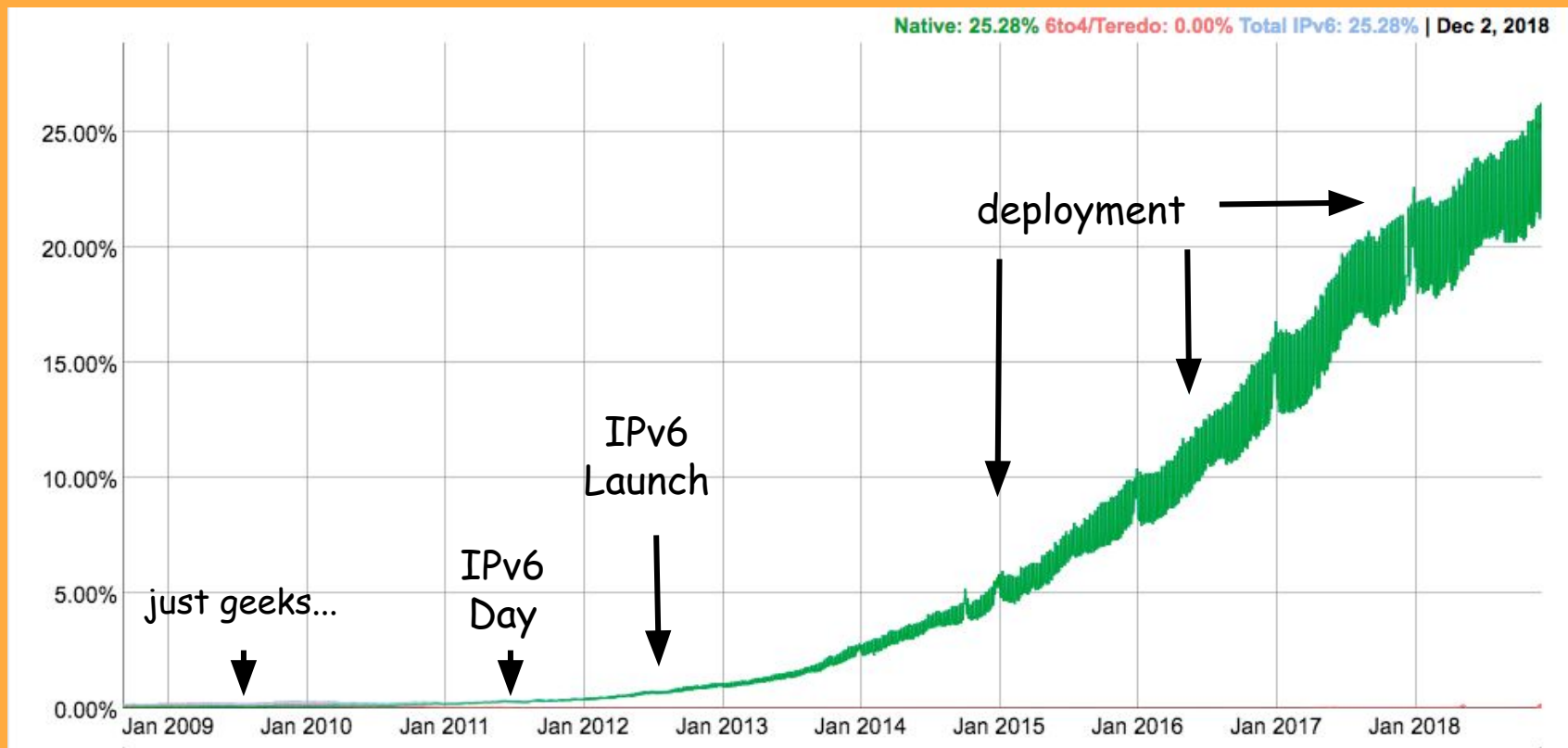
# 6 Misconceptions About IPv6

*Jen Linkova, [furry13@gmail.com](mailto:furry13@gmail.com)*

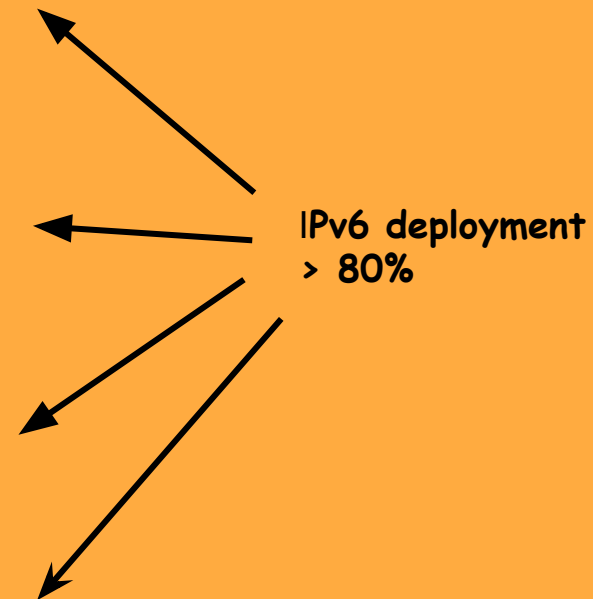
# Misconception #1

"It's Been 25 Years,  
IPv6 Is Not Going to Be Deployed"

# Obligatory IPv6 Adoption Graph



Rank ^	Participating Network ^	ASN(s) ^	IPv6 deployment ^
1	<a href="#">Comcast</a>	7015, 7016, 7725, 7922, 11025, 13367, 13385, 20214, 21508, 22258, 22909, 33287, 33489, 33490, 33491, 33650, 33651, 33652, 33653, 33654, 33655, 33656, 33657, 33659, 33660, 33661, 33662, 33664, 33665, 33666, 33667, 33668, 36732, 36733	66.48%
2	<a href="#">KDDI</a>	2516	44.12%
3	<a href="#">RELIANCE JIO INFOCOMM LTD</a>	55836, 64049	85.15%
4	<a href="#">SoftBank</a>	17676	36.30%
5	<a href="#">Charter Communications</a>	7843, 10796, 11351, 11426, 11427, 12271, 20001, 20115, 33363	43.66%
6	<a href="#">ATT</a>	6389, 7018, 7132	68.28%
7	<a href="#">Deutsche Telekom AG</a>	3320	58.42%
8	<a href="#">Verizon Wireless</a>	6167, 22394	87.48%
9	<a href="#">Vivo</a>	10429, 11419, 18881, 19182, 26599, 27699	48.20%
10	<a href="#">Claro Brasil</a>	4230, 28573	48.02%
11	<a href="#">Chunghwa Telecom (HiNet)</a>	3462, 9680, 17419	18.21%
12	<a href="#">Liberty Global</a>	5089, 6830, 20825, 29562	20.74%
13	<a href="#">T-Mobile USA</a>	21928	92.90%
14	<a href="#">TELMEX</a>	8151	29.28%
15	<a href="#">SKTelecom</a>	9644	38.26%
16	<a href="#">Chunghwa Telecom (Mobile)</a>	17421	62.51%
17	<a href="#">British Sky Broadcasting</a>	5607	84.37%



<https://www.worldipv6launch.org/measurements/>

# Not There Yet: Mentality Shift

Ask an engineer to draw an example network with addresses. Watch IPv4 addresses on the diagram.

*Bonus point: for using the correct example networks (RFC3849, RFC5737)*

Ask an engineer to test if Internet is working. Watch IPv4 addresses be pinged.

## Misconception #2

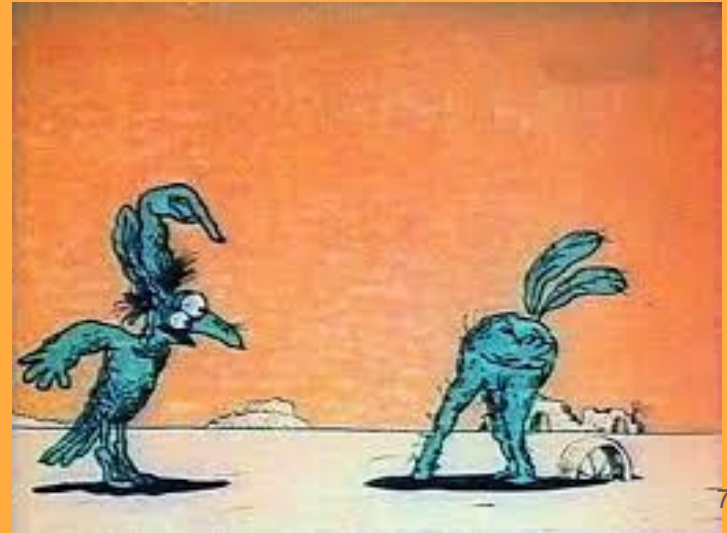
**"I Do Not Need IPv6"**

# If You Won't Come to IPv6 Then IPv6 Must Come to You!

"IPv4-Only network" might mean "dual-stack"

No controlled IPv6 deployment:

No IPv6 Security



# IPv6 and DNSSEC

IPv6-Only Networks (e.g. mobile devices) use DNS64

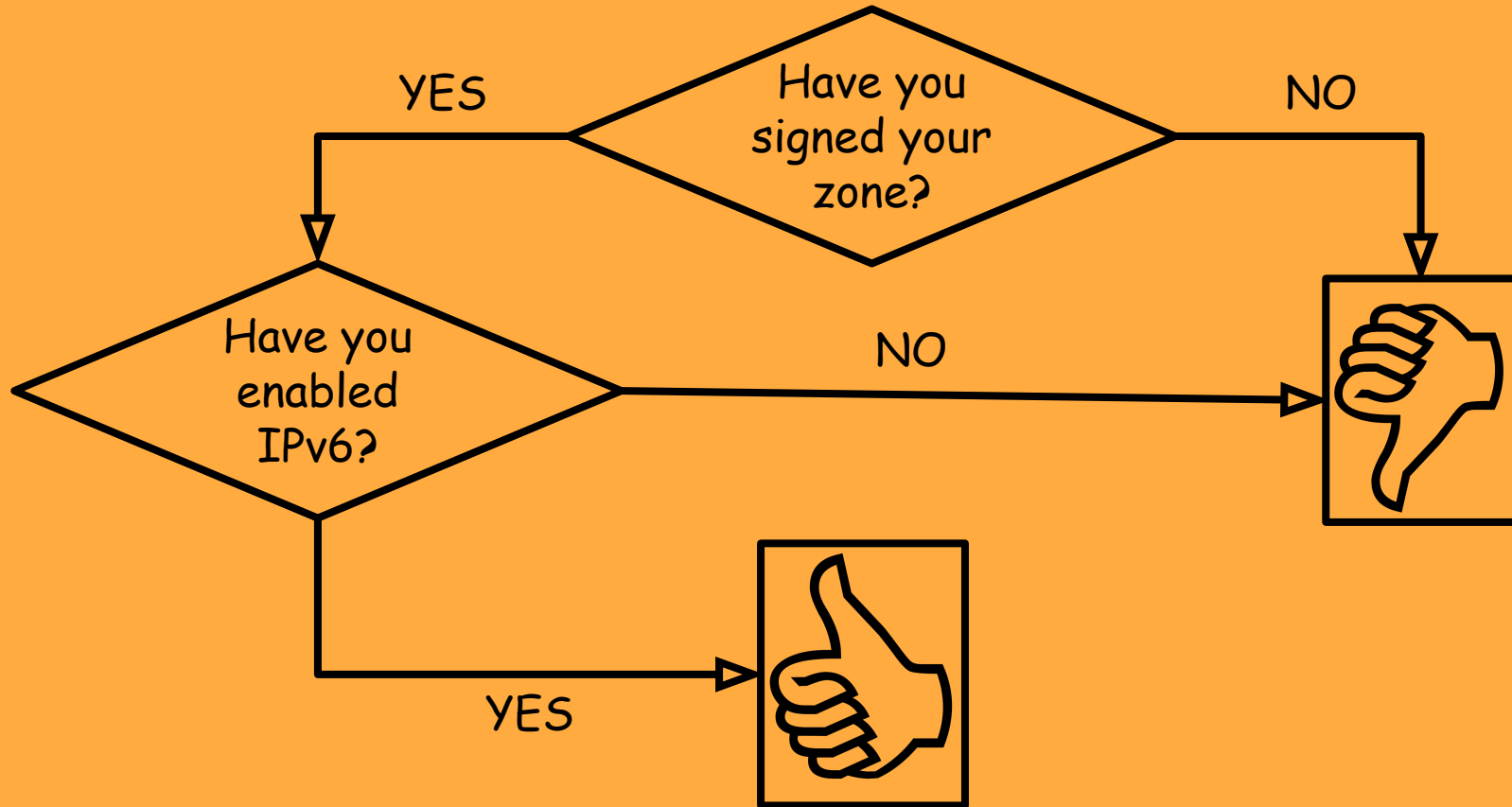
DNS64 synthesises AAAA for IPv4-only names:

```
furrry@Wintermute:~>dig @2001:4860:4860::6464 ipv4.google.com a +short  
ipv4.l.google.com.  
172.217.25.174  
furrry@Wintermute:~>dig @2001:4860:4860::6464 ipv4.google.com aaaa +short  
ipv4.l.google.com.  
64:ff9b::acd9:19ae
```

DNS64 would not work for IPv6-only validating clients



# IPv6 and DNSSEC



# Performance Impact

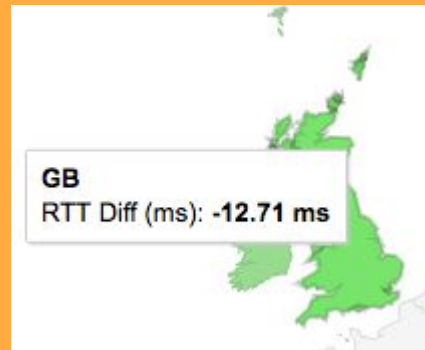
## IPv6 can perform better than IPv4 in mobile

The simpler network architecture for native IPv6 traffic in mobile networks (with fewer middle-boxes between the handset and the Internet) translates into better performance. In IPv6-only mobile networks (and in some types of dual-stacked mobile networks that transport IPv4 traffic in an IPv6 tunnel to a NAT44), IPv6 traffic has direct access to the Internet while IPv4 traffic has its access mediated through a NAT. These NATs add latency and can be bottlenecks as they can be expensive for ISPs to deploy enough capacity to keep up with demand.

Akamai, Facebook, and LinkedIn have all conducted RUM (Real User Measurement) studies comparing relative performance between IPv6 and IPv4 for dual-stacked mobile devices. These studies have shown significant performance improvements for IPv6 over IPv4 in the top-4 US mobile networks, with page load times improving by well over 10%. This translates to enabling IPv6 for content resulting in a better user experience and better user engagement for significant numbers of mobile users in the US and elsewhere in the world.

<https://blogs.akamai.com/2016/06/preparing-for-ipv6-only-mobile-networks-why-and-how.html>

<https://stats.labs.apnic.net/v6perf>



# IPv6 Availability

*Percentage of connections made on a network  
that offered IPv6 connectivity*

	Wi-Fi	Cellular
Global	29%	44%
US	39%	87%
UK	32%	0.12%

# Some Implications of Growing IPv6 Adoption

Do your systems (e.g. VPN) support IPv6?

So when (**not if**) your colleagues (e.g. managers) get connected to IPv6-only public network...

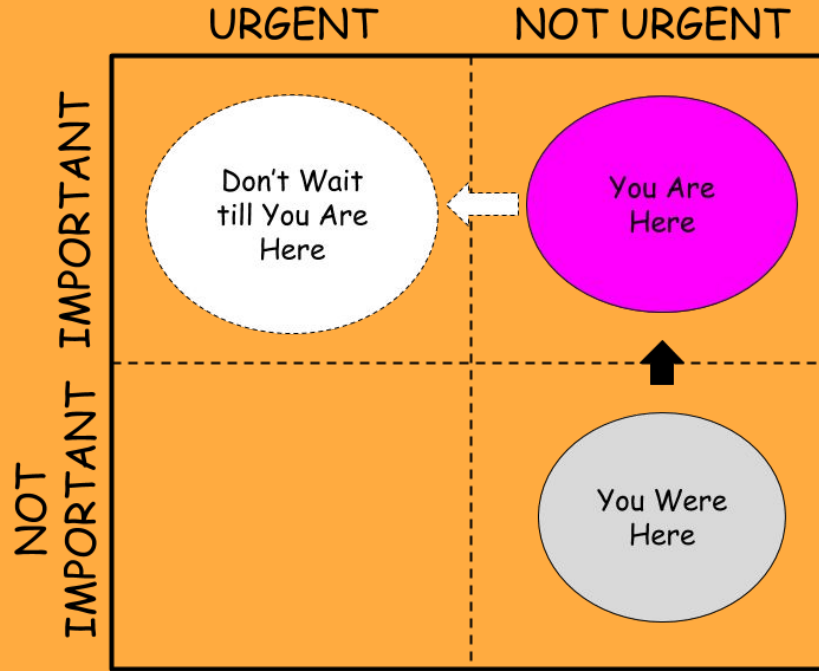
# Misconception #3

"I'll Think About It Tomorrow"

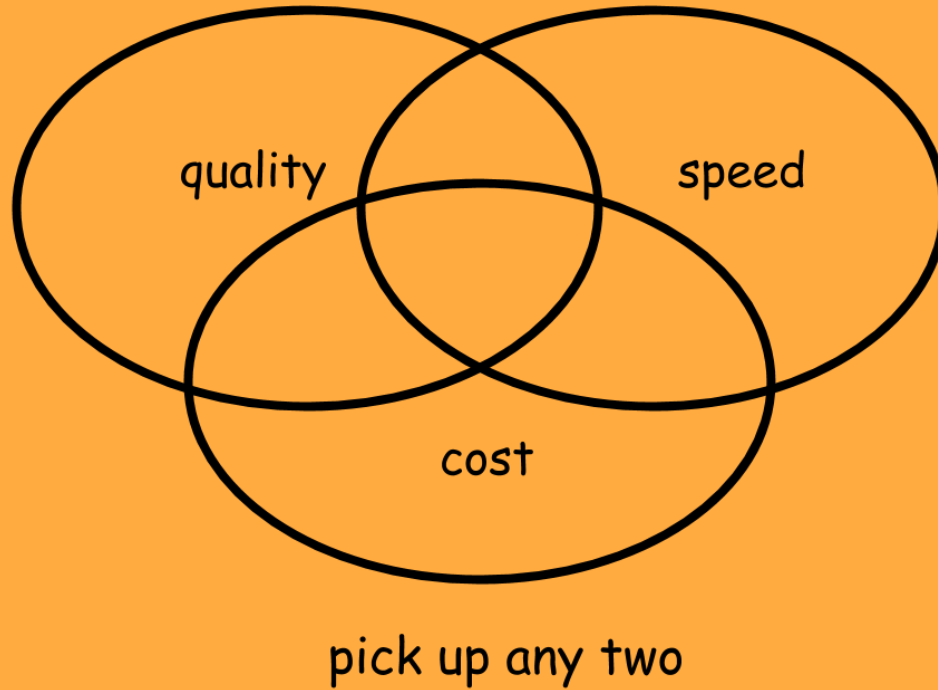
- *Scarlett O'Hara* -



# The Eisenhower Method & IPv6



# If You Have to Deploy IPv6 Tomorrow..



# Think About It Today!

Consider:

- Mindset changes
- Education/Training
- Software/hardware lifecycle periods
  - How long does it take to get a bug fixed/a feature implemented?
- Workflow changes

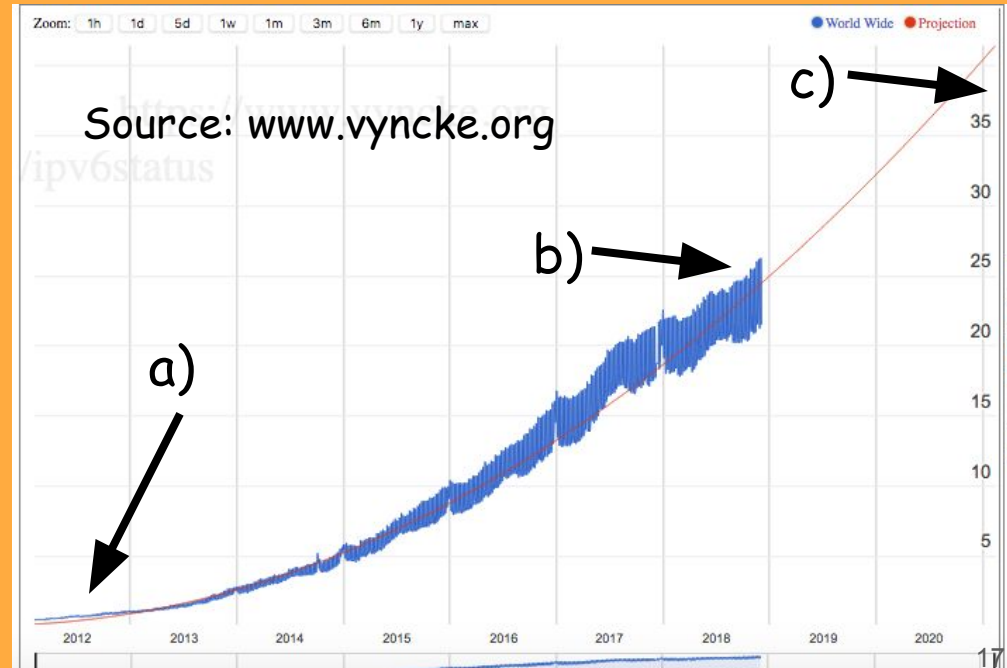


# DON'T: "Launch Now in IPv4-mode, Enable IPv6 Later"

Quiz Q: What would be the best time to touch production systems?

Answers:

- a) Back in 2012 (< 1% adoption)
- b) Now (~25% adoption)
- c) In 2021 (~40% adoption)

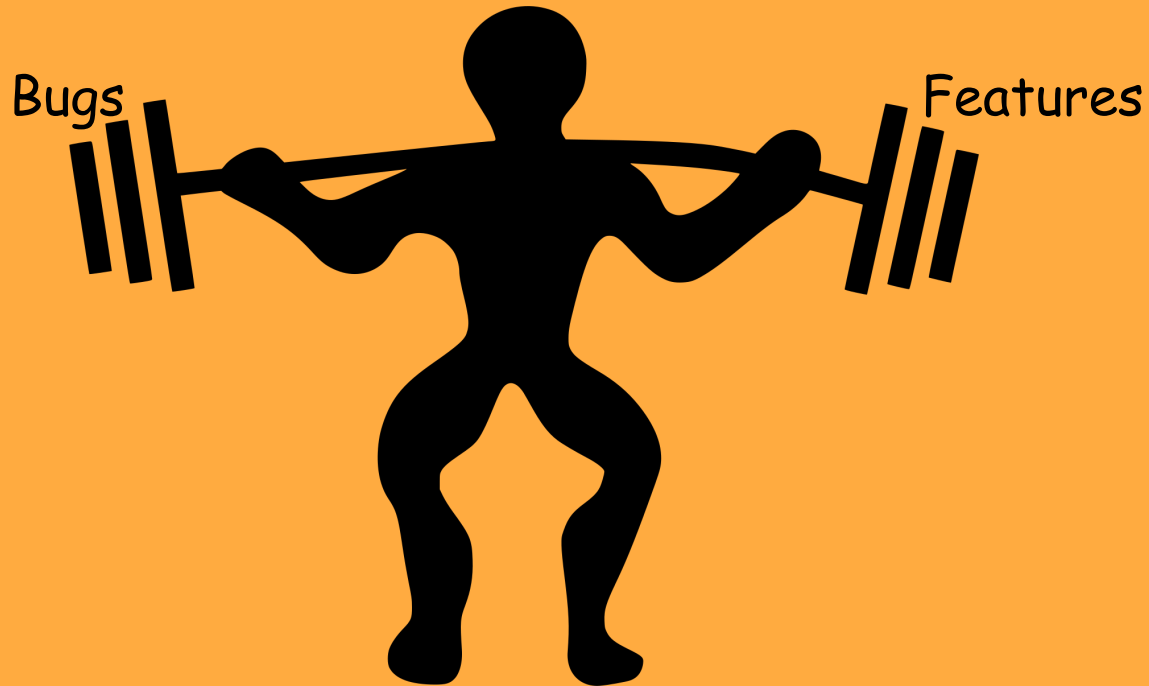


# Good News, Everyone!



## IPv6 Is Getting Easier to Deploy

# Heavy Lifting Done by Early Adopters



## Misconception #4

“IPv6 Is Just like IPv4  
but with More Addresses”

# One Netmask To Rule Them All

Address Plan Simplified:

- /128 for loopback
- /127 for p2p
- /64 for everything else



# Host Configuration Simplified

Router Advertisement contains all network configuration

- IPv6 prefixes
- Router info
- DNS info
- MTU

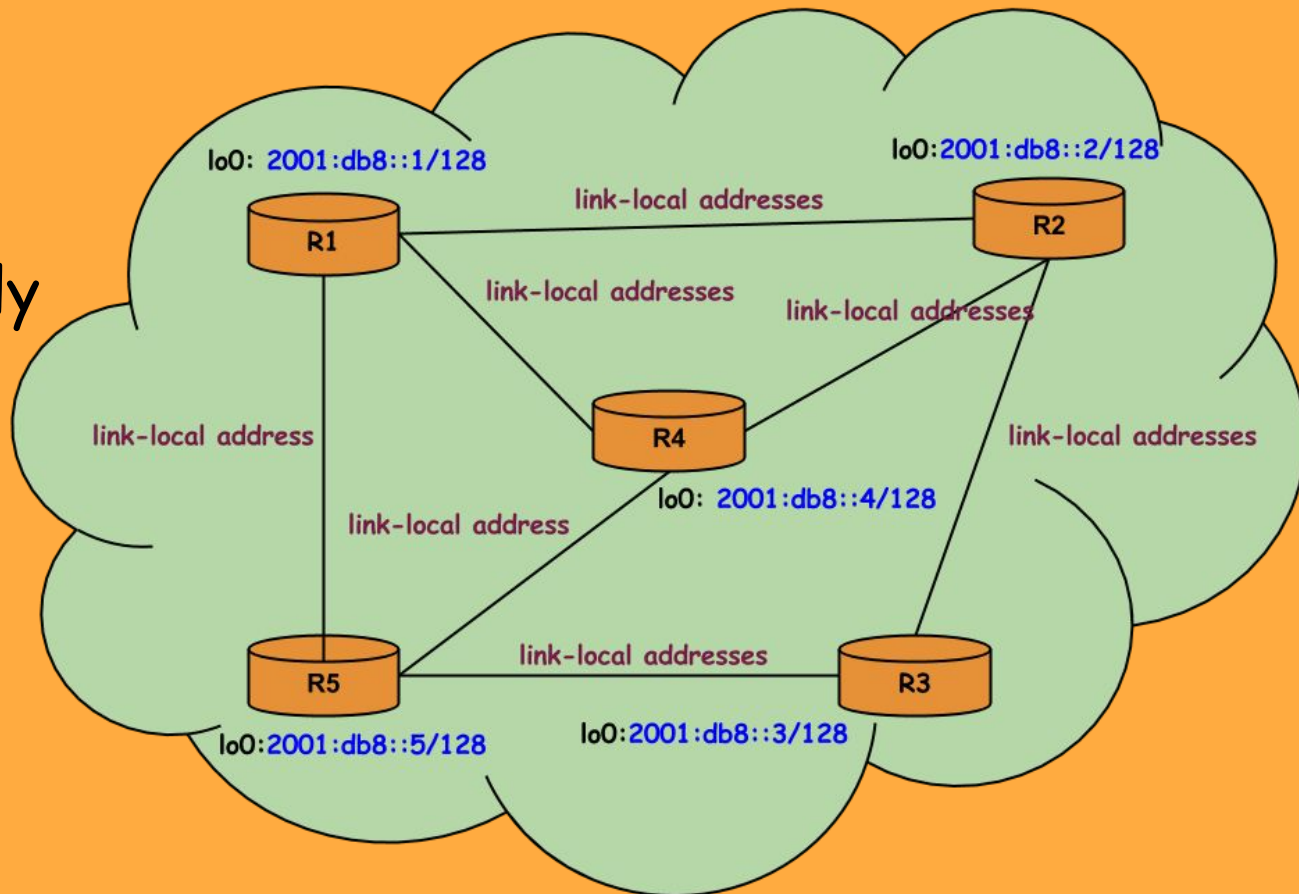
Network changes are signalled back to hosts

Multiple Addresses per host (think per application)

# Link-Local Addresses

Use Case:

Link-Local Only  
Backbone  
RFC7404



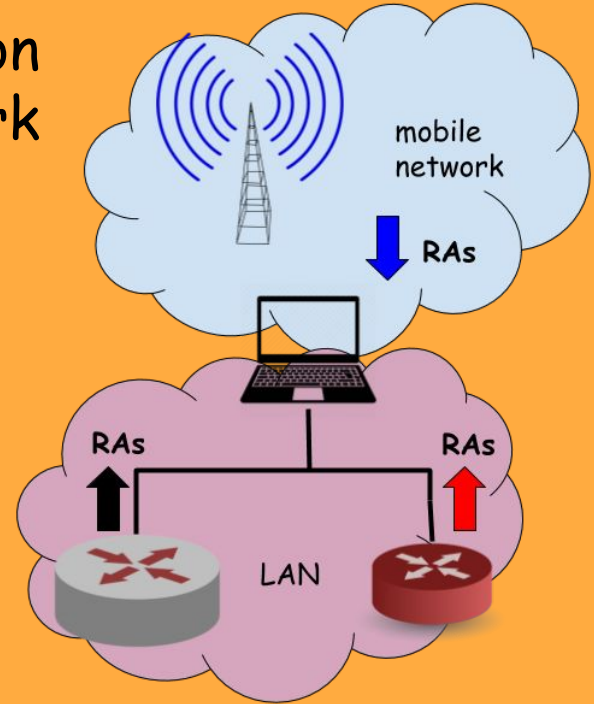
# Multiple Provisioning Domains

Provisioning Domain: a set of configuration information specific for the given network

- IP prefixes
- Default routers
- DNS
- Captive Portal presence
- Costs etc

PVD info provided via RAs

Hosts associate configuration with the specific PVD





## **Misconception #5**

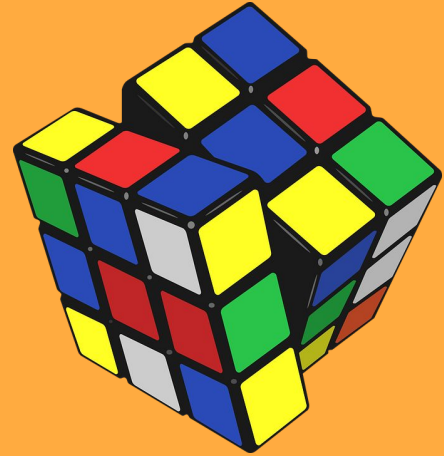
**“IPv6 Is Too Complicated!”**

# Is It Really? Or Is It Just "Not IPv4"?

IPv6 is quite logical [*disclaimer: IMHO*]

Problem => Solution

Problem might not be so obvious though



We have OSPF, EIGRP, MPLS, BGP and multicast!

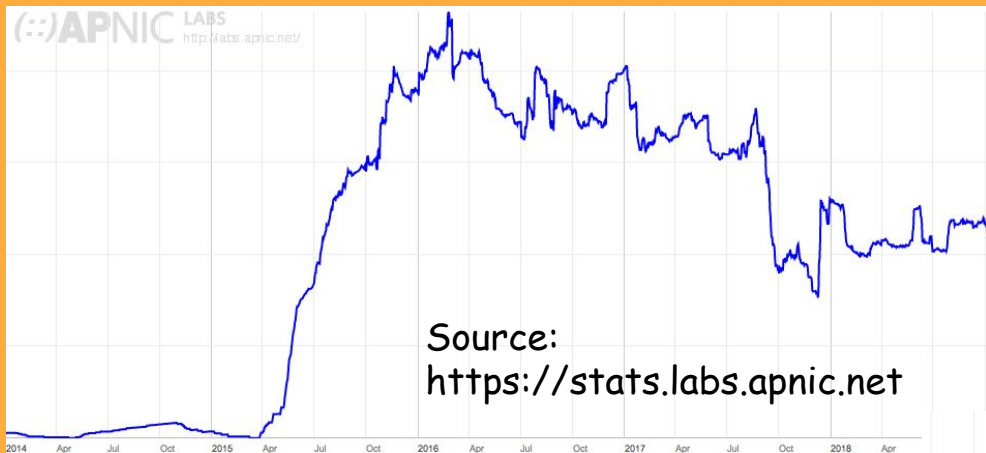
Recommended Reading: "IPv6 for IPv4 Experts" book  
<https://sites.google.com/site/yartikhiy/home/ipv6book>

**Misconception #6**  
**"I've Enabled IPv6.**  
**I'm DONE!"**

# Main Question: Is IPv6 Being Used?



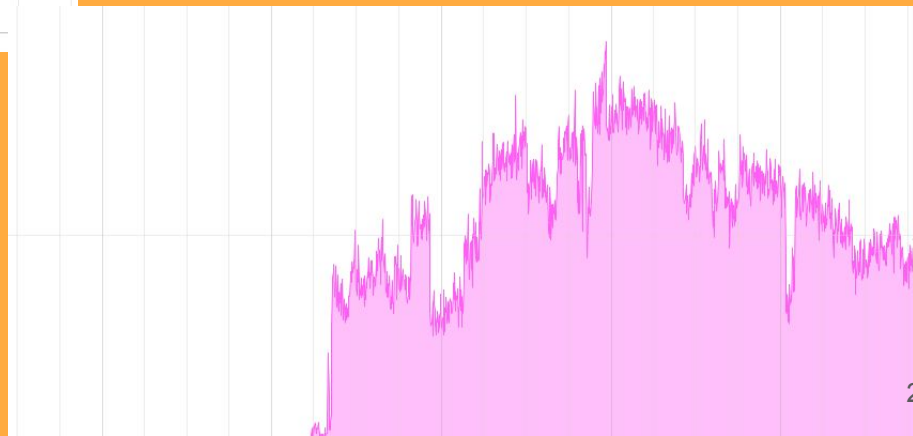
# Case Study #1: A Random ISP



50% traffic decrease in ~18 months

New CPEs have broken IPv6

Came as a surprise to them...



# Case Study #2: A Random WiFi Network

End hosts on IPv6-enabled network:

- receiving Router Advertisement
- getting IPv6 stack configured
- losing IPv6 connectivity 5 second later.

Wireless controller was sending malformed packets on behalf of the router.

Nobody noticed for a while

# Questions To Ask Yourself

- Is IPv6 working?
- Is it used? Any Happy Eyeballs failures?
- Bonus Points for:
  - What are IPv4 dependencies?

# Solutions

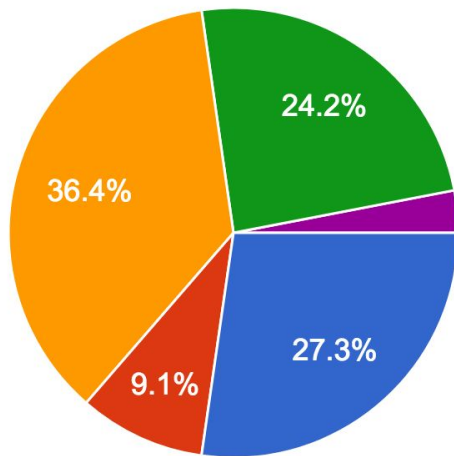
- Monitor
  - IPv6 traffic trends
  - end2end connectivity
    - Both protocols
- Consider disabling IPv4 whenever possible



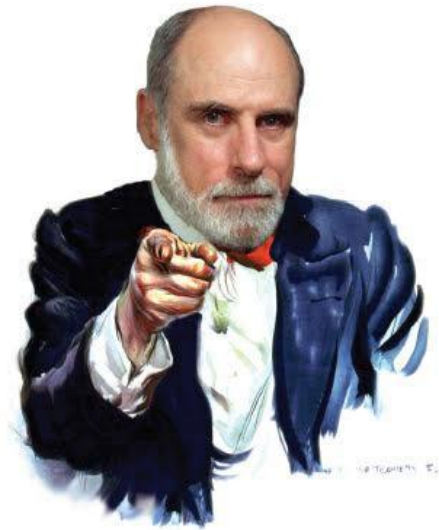
# We Did Try It

What was your overall experience with NAT64?

IETF100, Nov 2017, Singapore



- Everything worked just fine
- No particular application failures but the network was unstable
- Some applications did not work but I was still able to get my work done
- I can not get my work done on NAT64 network
- I only tried with my phone: it could not connect to the encrypted networks, but nat64-unencrypted worked fine f...



**I WANT YOU  
TO USE IPv6**

— VINT CERF