6 Misconceptions About IPv6

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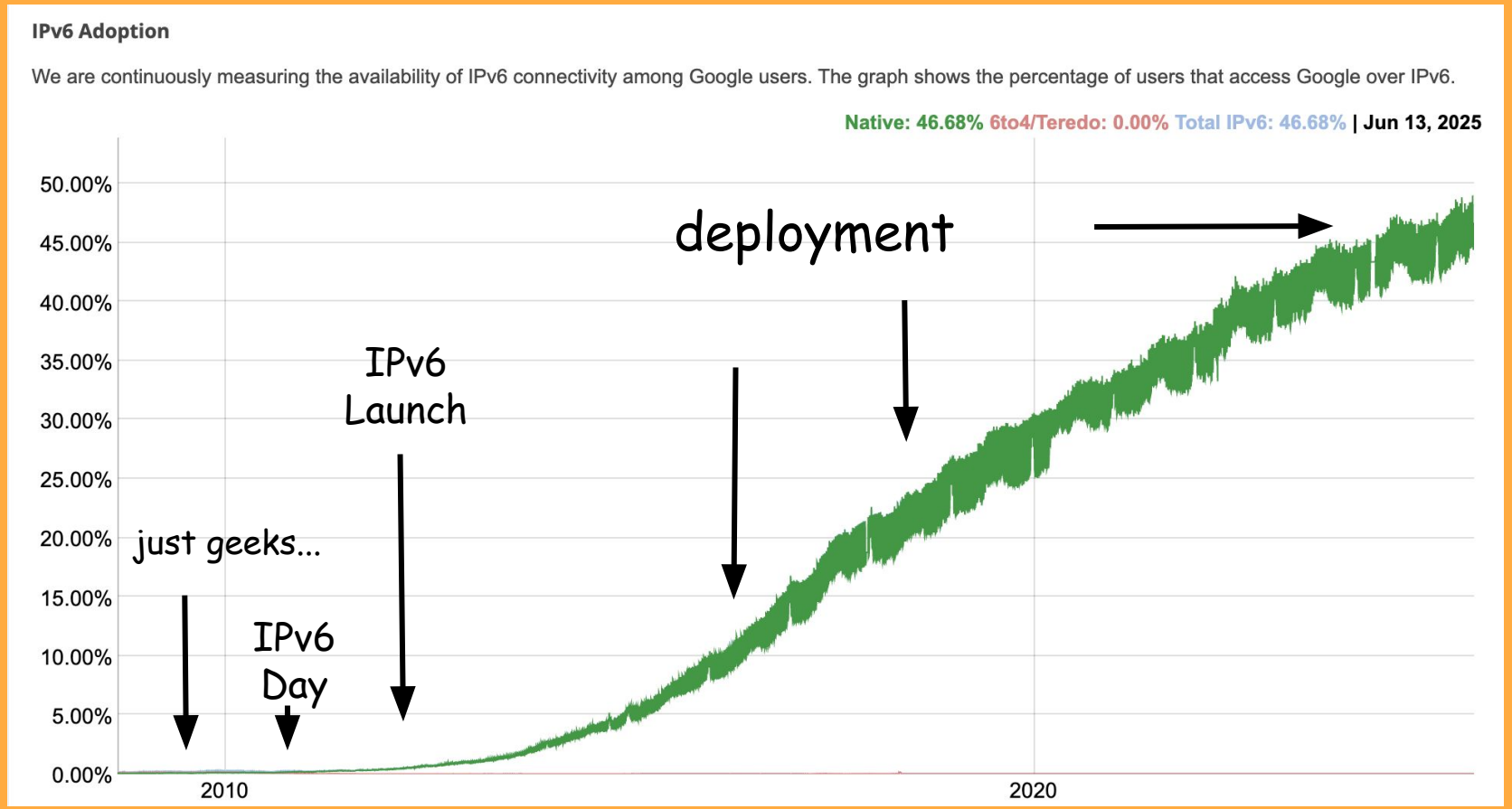
Misconception #1

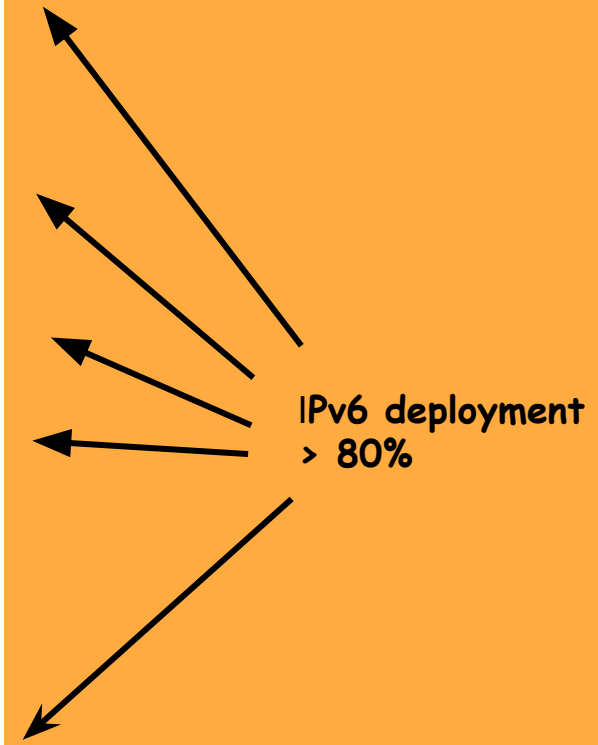
"It's Been 25 Years,

IPv6 Is Not Going to Be Deployed"

Obligatory IPv6 Adoption Graph



Rank	Participating Network	ASN(s)	IPv6 deployment
1	RELIANCE JIO INFOCOMM LTD	55836, 64049	92.58%
2	Comcast	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	73.62%
3	Combined US Mobile Carriers	3651, 6167, 10507, 20057, 21928, 22394	87.74%
4	Charter Communications	7843, 10796, 11351, 11426, 11427, 12271, 20001, 20115, 33363	56.41%
5	ATT	6389, 7018, 7132	72.32%
6	T-Mobile USA	21928	92.31%
7	Deutsche Telekom AG	3320	74.48%
8	Orange Business Services	3215	74.08%
9	Verizon Wireless	6167, 22394	83.58%
10	Claro Brasil	4230, 28573	74.53%
11	KDDI	2516	73.58%
12	Viettel Group	7552	57.85%
13	TELMEX	8151	64.50%
14	Vivo	10429, 11419, 18881, 19182, 26599, 27699	73.04%
15	SoftBank	17676	53.11%
16	Cox Communications	22773	64.07%
17	Liberty Global	5089, 6730, 6830, 6848, 33915	32.21%
18	British Sky Broadcasting	5607	79.62%
19	Free	12322	88.00%
20	BT	2856, 25127	69.41%
21	AT&T Wireless	20057	84.60%



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

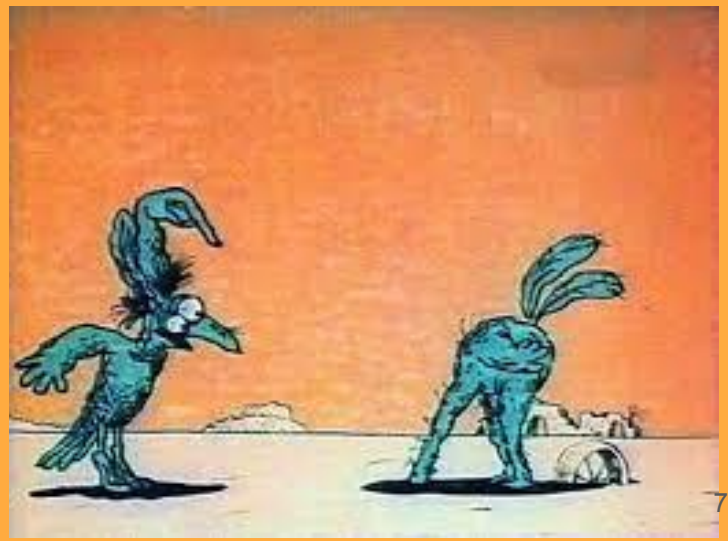
“I Do Not Need IPv6”

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

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

No controlled IPv6 deployment:

No IPv6 Security



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...

IPv6-Only, Yes. No Kidding!

Mobile operators

Public/Enterprise WiFi: IPv6-mostly mode

- Google enterprise network
- Various conferences (RIPE, IETF, and others)

IPv6 and DNSSEC

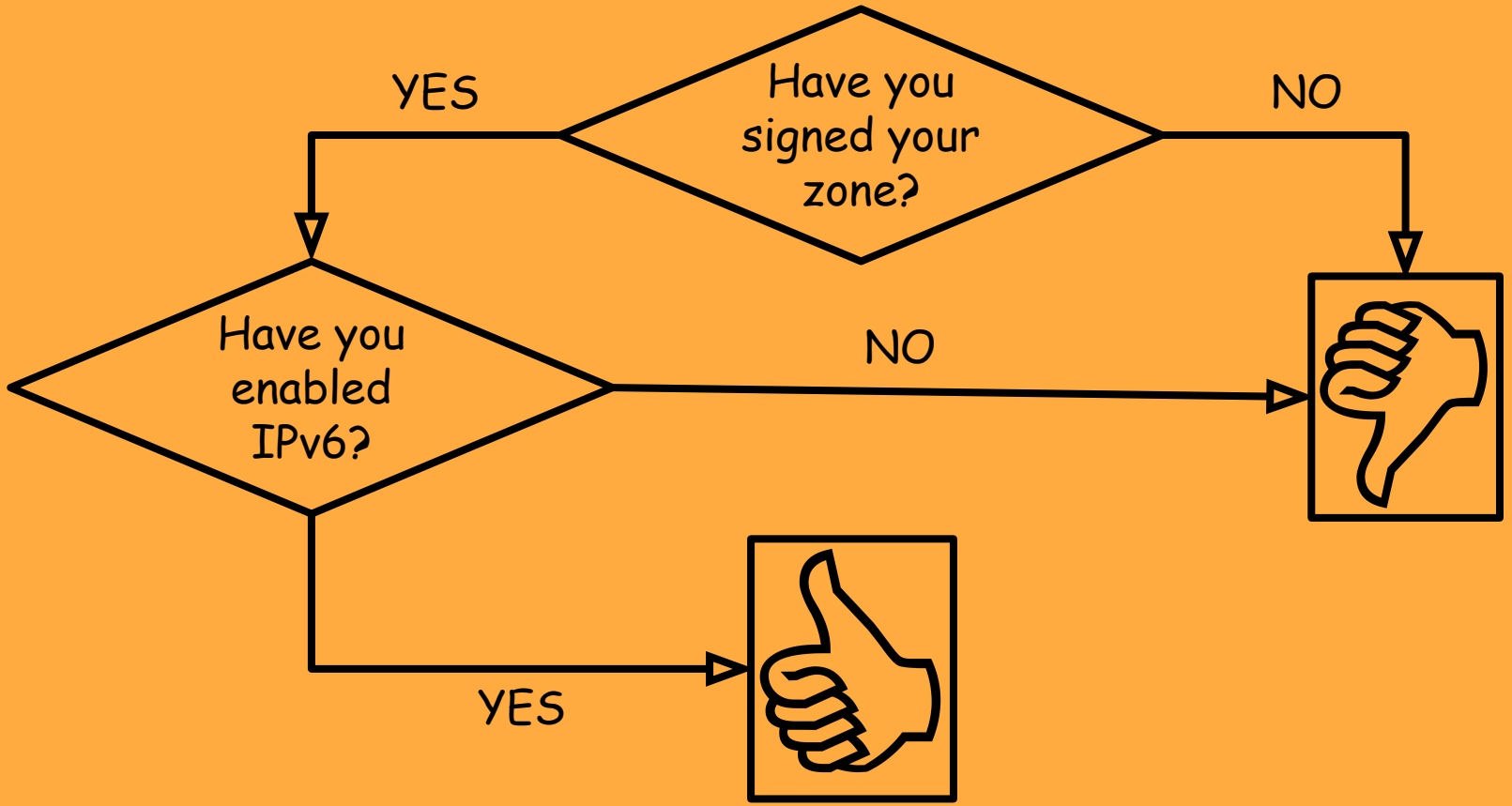
IPv6-Only Networks (e.g. mobile devices) use DNS64

DNS64 synthesises *AAAA* for IPv4-only names:

```
furry@Wintermute:~>dig @2001:4860:4860::6464 ipv4.google.com a +short
ipv4.l.google.com.
172.217.25.174
furry@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

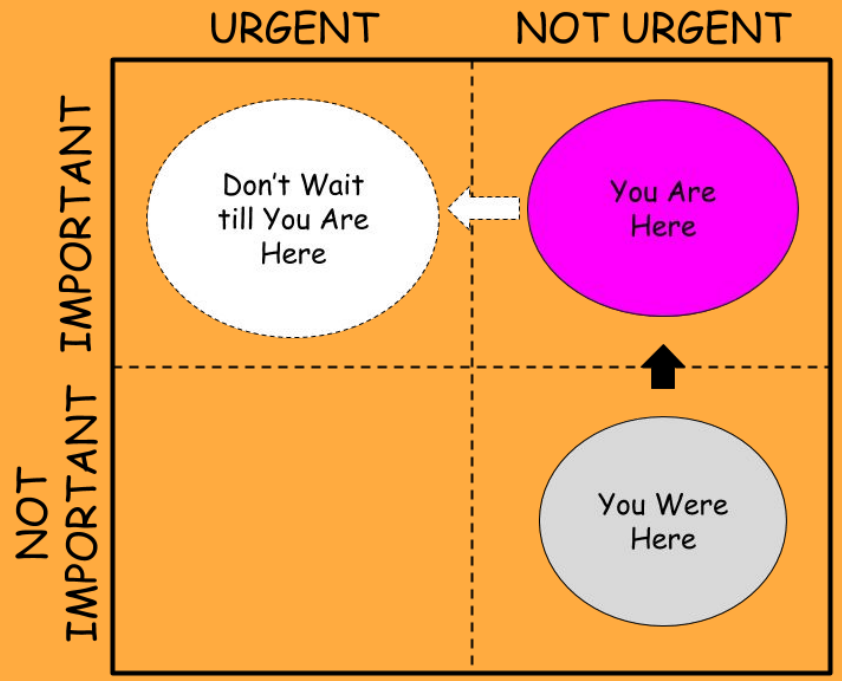


Misconception #3

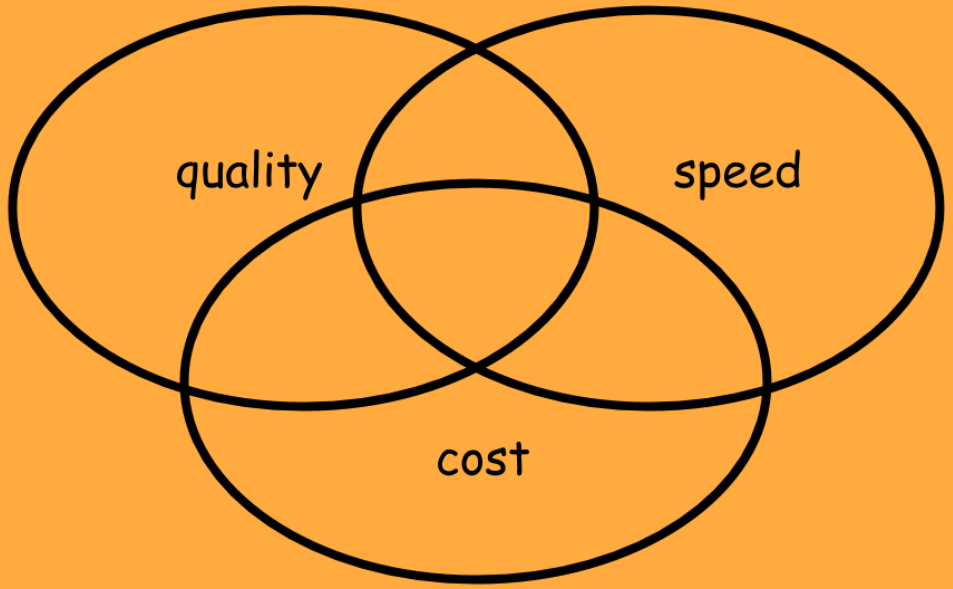
“I'll Think About It Tomorrow”

- Scarlett O’Hara -

The Eisenhower Method & IPv6



If You Have to Deploy IPv6 Tomorrow..



pick up any two

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

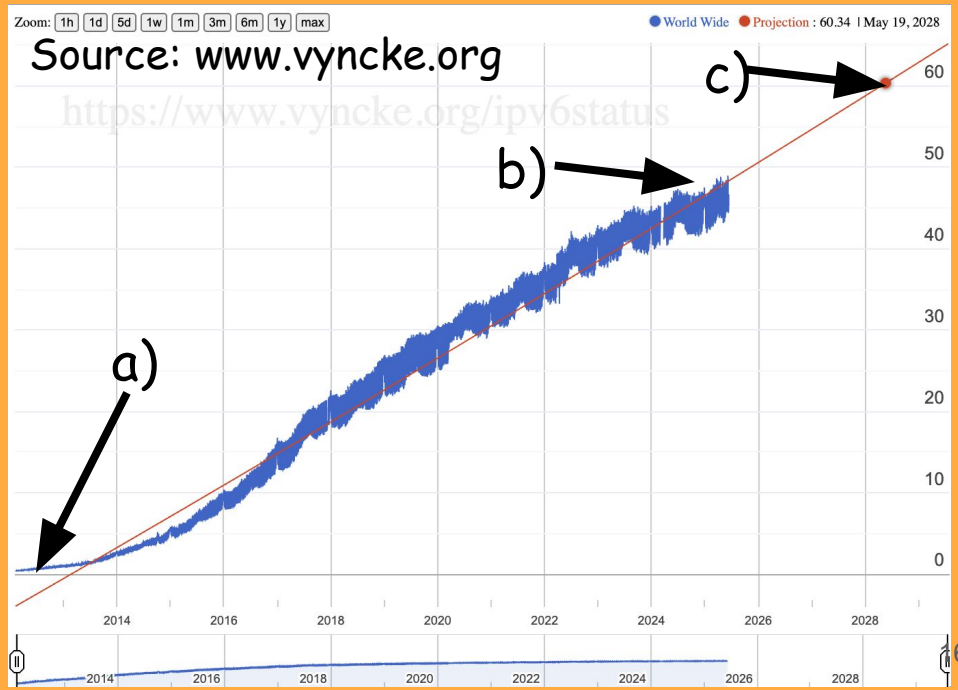
DON'T: "Launch Now in IPv4-mode, Enable IPv6 Later"

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

a) In 2012 (0.5% adoption)

b) Now (~48% adoption)

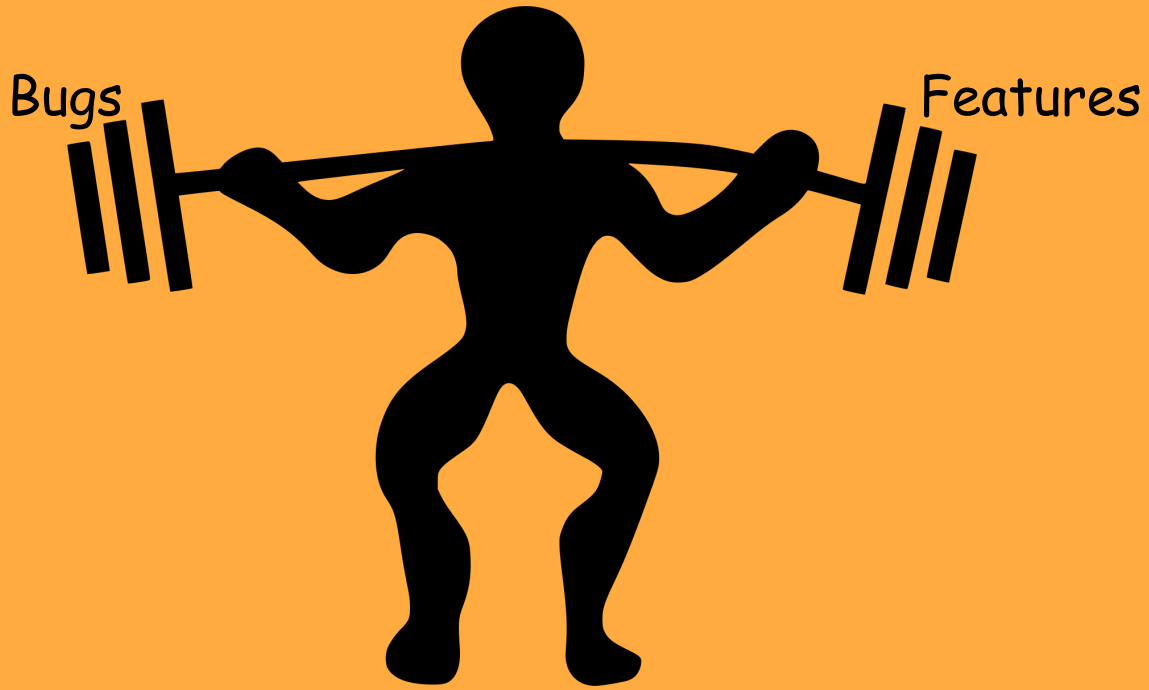
c) In 2028 (~60% adoption)



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 (and Prefixes) Per Interface

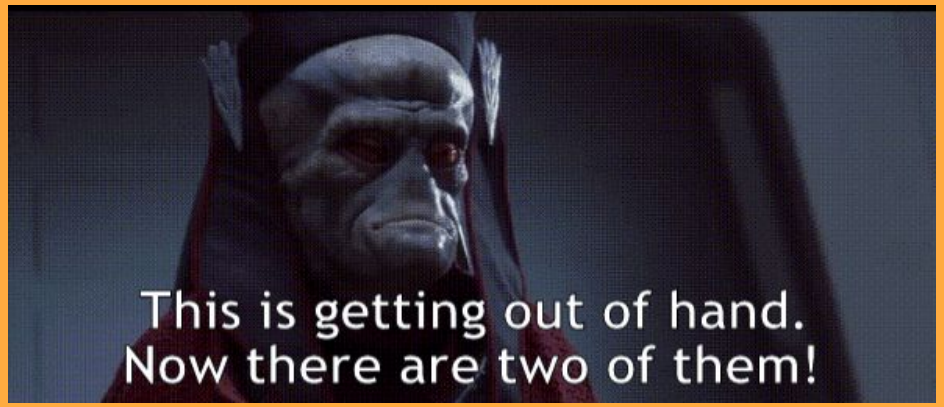
```
furry@Wintermute:~>ifconfig en0
en0: flags=8863<UP,BROADCAST,SMART,RUNNING,SIMPLEX,MULTICAST> mtu 1500
        ether 68:a8:6d:12:f7:b2
        inet6 fe80::6aa8:6dff:fe12:f7b2%en0 prefixlen 64 scopeid 0x4
        inet 172.30.85.221 netmask 0xfffffe00 broadcast 172.30.85.255
        inet6 2001:db8:9:9:6aa8:6dff:fe12:f7b2 prefixlen 64 autoconf
        inet6 2001:db8:9:9:8c7d:4d4d:4891:8cb5 prefixlen 64 autoconf temporary
        inet6 2001:db8:9:9:13:b96a:535f:a1fd prefixlen 64 autoconf secured
        inet6 2001:db8::6aa8:6dff:fe12:f7b2 prefixlen 64 autoconf
        inet6 2001:db8::4aa5:2101:4860:ab1f prefixlen 64 autoconf temporary
        inet6 2001:db8::561a:35af:fc8d:67fa prefixlen 64 autoconf secured
```

Modified EUI-64

stable

Why Multiple Addresses?

- Privacy
- Multihoming (*)
- Graceful Renumbering
- Service-specific IPs
- ULAs for internal (*)

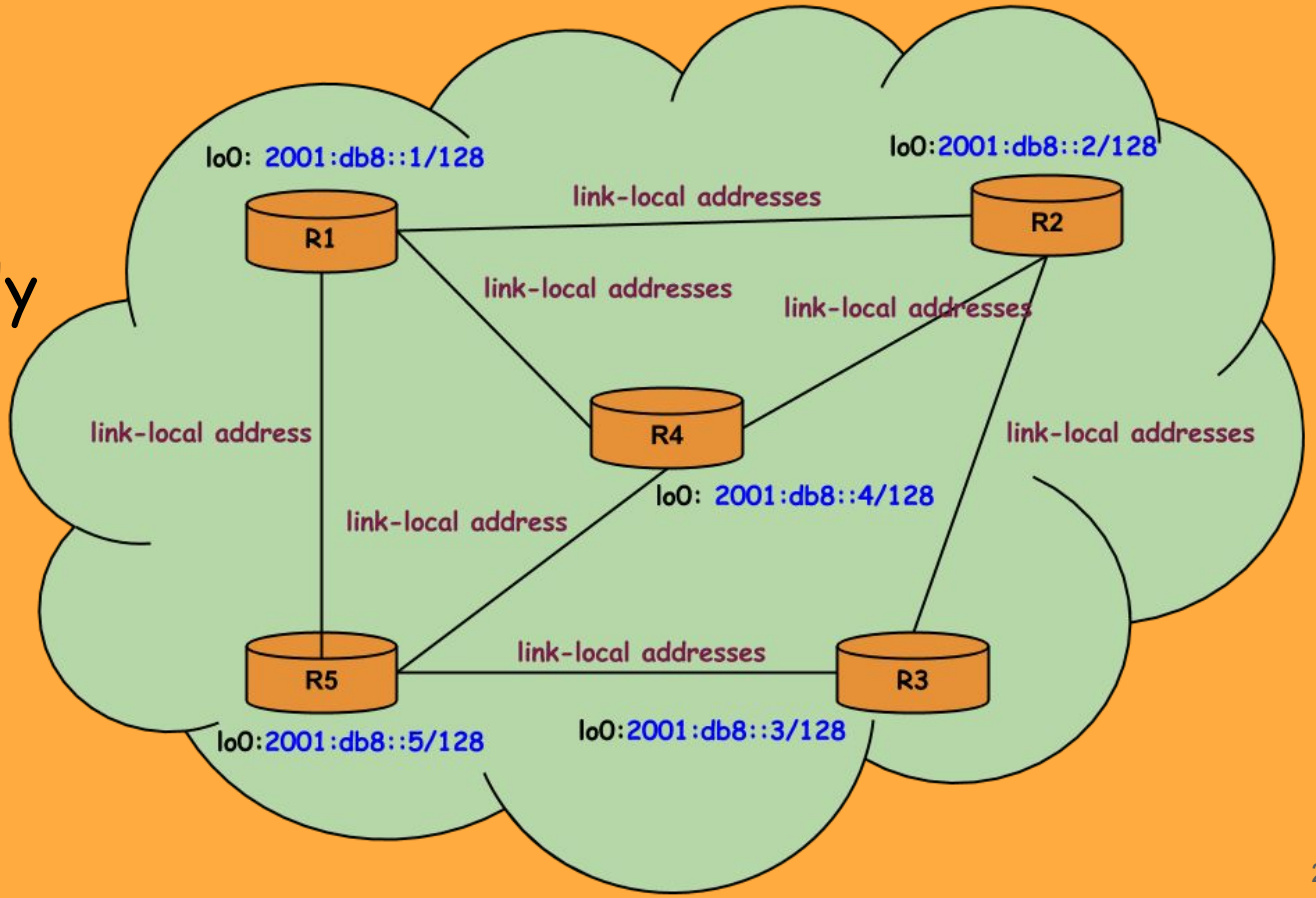


(*) work in progress

Link-Local Addresses

Use Case:

Link-Local Only Backbone
RFC7404



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!

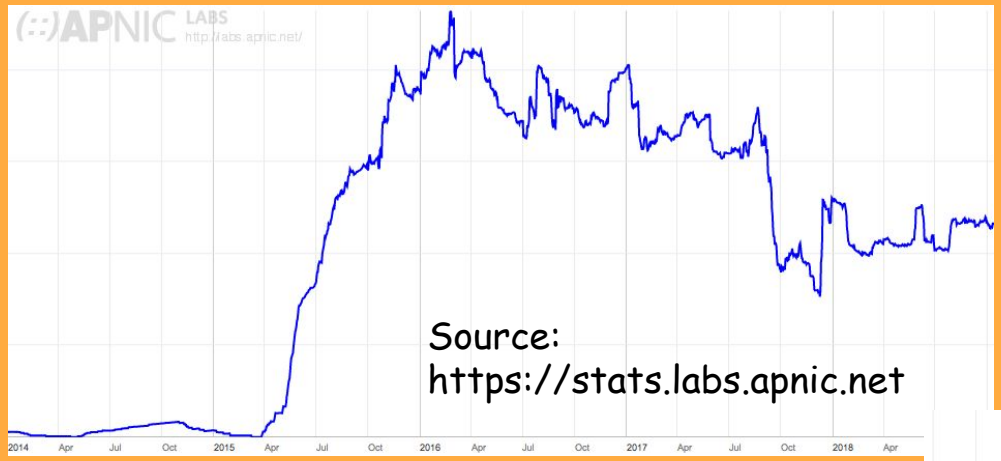
Recommended Reading: "IPv6 for IPv4 Experts" book
https://sites.google.com/site/yartikhiy/home/ipv6book

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...

A Random Enterprise WiFi Network

Case 1

- Wireless controllers send malformed packets
- Hosts losing IPv6 connectivity every 30 secs

Case 2

- Hosts losing IPv6 DNS config after waking up,
- No IPv6 DNS for up 10 mins

2011

Happy Eyeballs Hides Broken IPv6

2025

Happy Eyeballs Hides Broken IPv6

You Are Not Operating IPv6

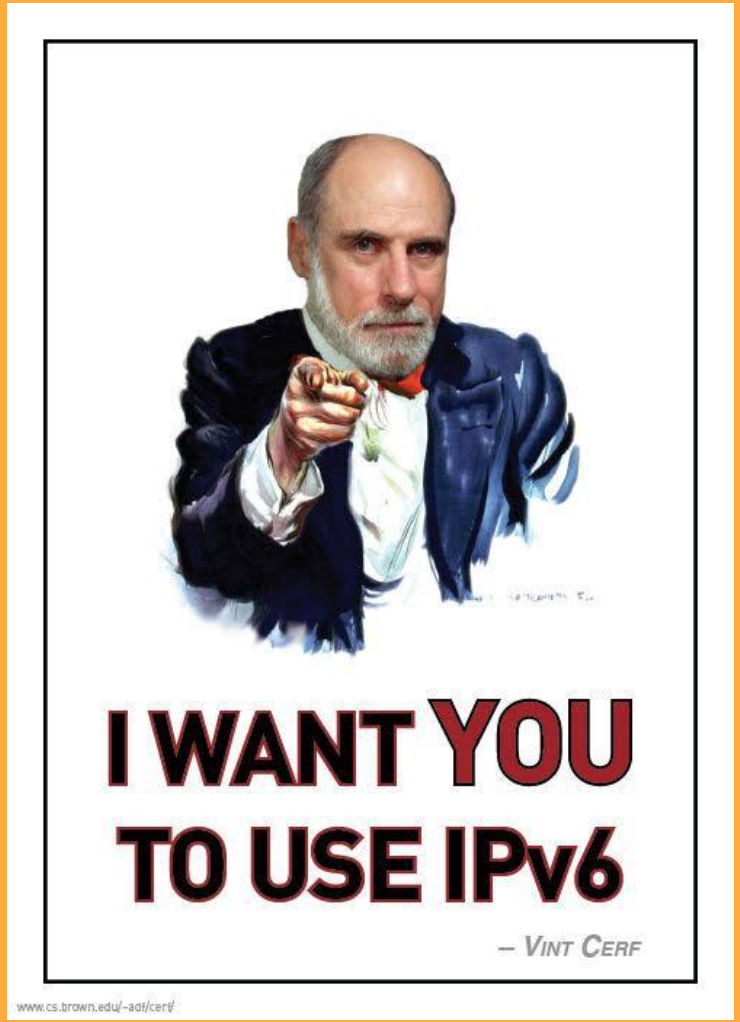
Until

You Turn IPv4 Off

Dual-Stack Doesn't Solve the IPv4 Exhaustion Problem

Action Plan

- ❑ Deploy IPv6
- ❑ Monitor IPv6
- ❑ Start disabling IPv4 and migrate to IPv6-mostly
  - ❑ Deployment Considerations


I WANT YOU
TO USE IPv6
– VINT CERF
www.cs.brown.edu/~adf/cerf/