



A little IPv6 History

Fred Baker

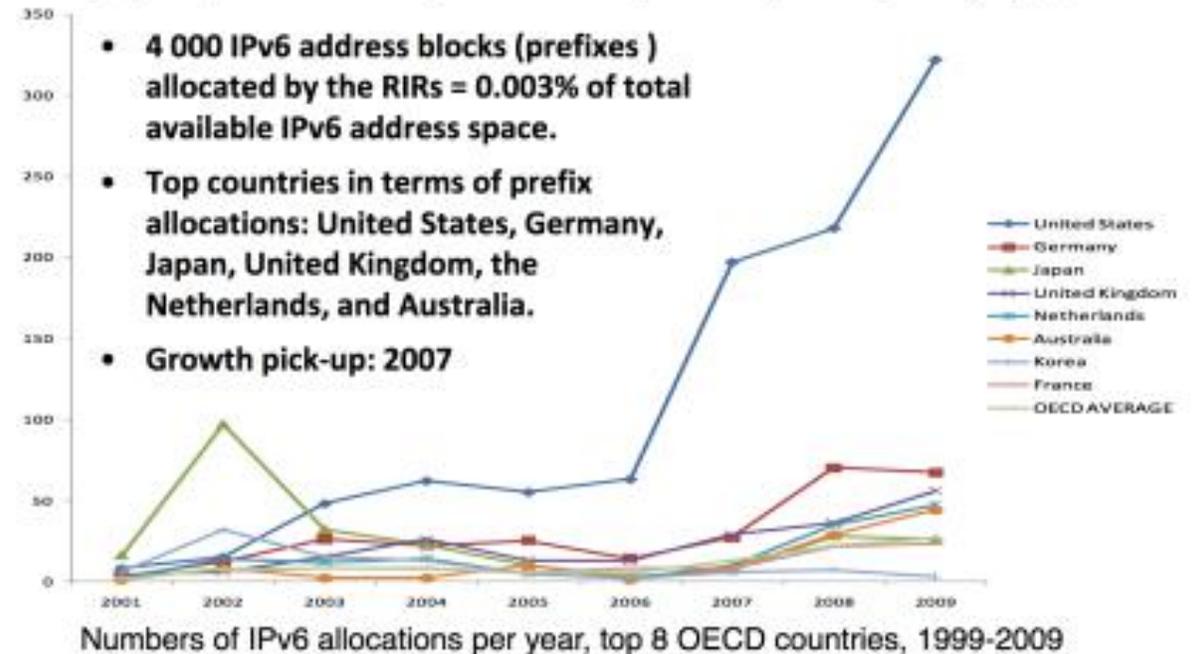
History of IPv6

- 1990: IETF realized that IPv4 address space would run out
 - Took steps to alleviate that
- 1993, IETF requested proposals for “next generation” protocol
 - IPv6 proposed in 1994 (among other proposals)
 - Translation proposed in 1998; extended life of IPv4 Internet by ~15 years
 - IPv6 standardized in 1998
 - Research trial deployments...
 - Supporting work in DHCP, DNS, routing protocols, etc.
 - Implementation in various operating systems; Linux and MacOS early, Windows late
- Uptake of prefixes started 2007
 - ICANN policy for prefix allocation 2006
 - IP Journal discussion: Fred Baker, John Klensin, Geoff Huston, and Tony Hain commented on IPv6 deployment
 - Tokyo University report on reality of IPv4 exhaustion predictions
- IANA allocation of last IPv4 /8 prefixes in 2011



Infrastructure readiness: RIR allocations of IPv6 address blocks

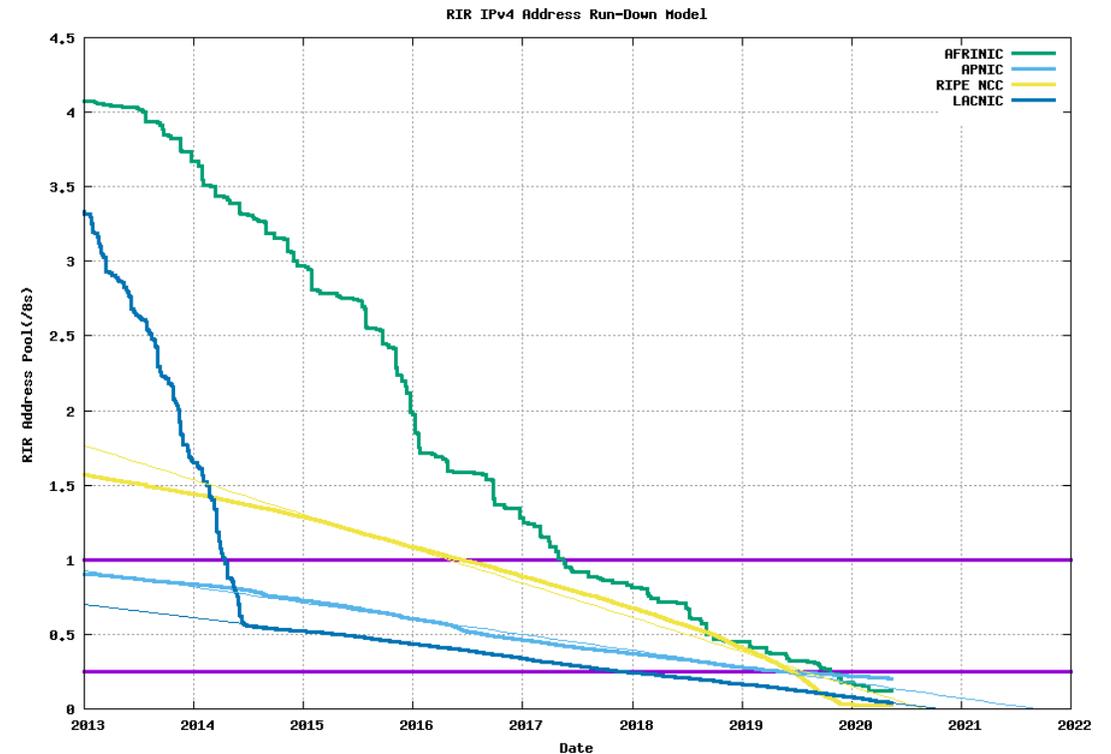
RIR allocations of IPv6 address space shows interest in potential IPv6 deployment, since obtaining IPv6 address space is a first step in deploying IPv6.



<https://www.oecd.org/sti/ieconomy/44961688.pdf>

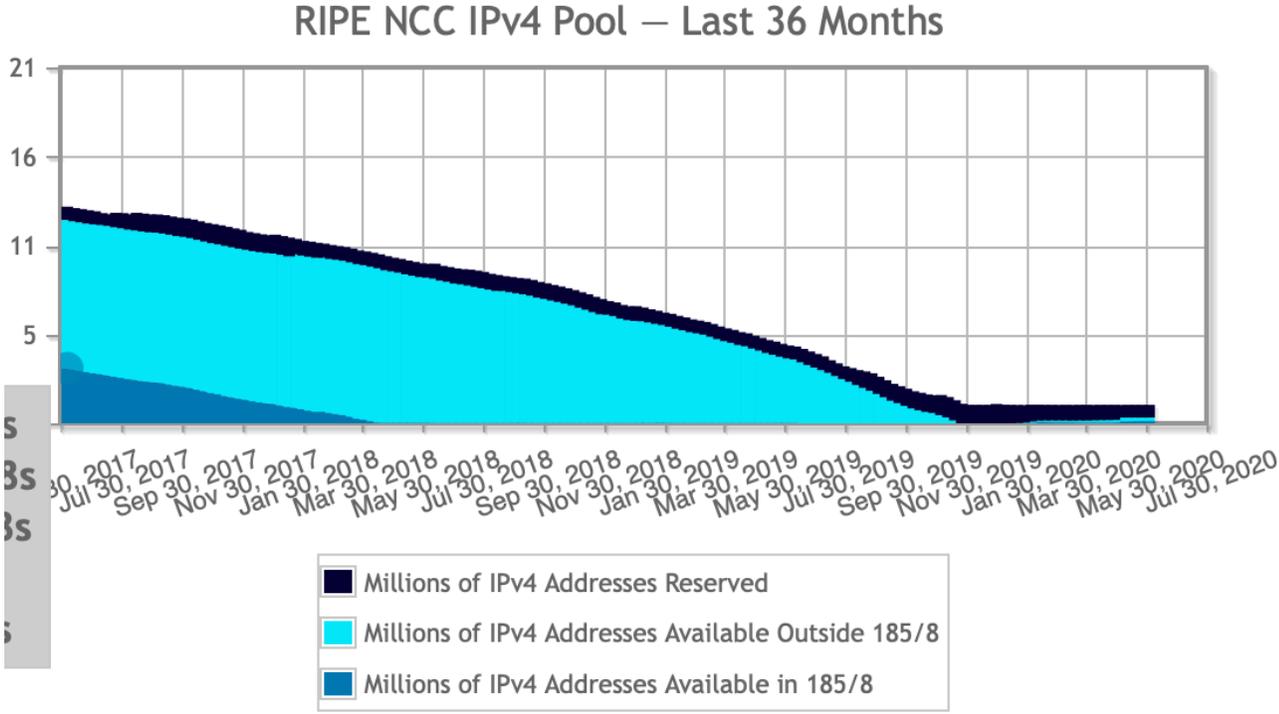
Exhaustion timeframes

- All RIRs have now entered their respective end phases
 - Lots of IPv6 prefixes to allocate
 - IPv4 only for new entrants, and then in small quantities



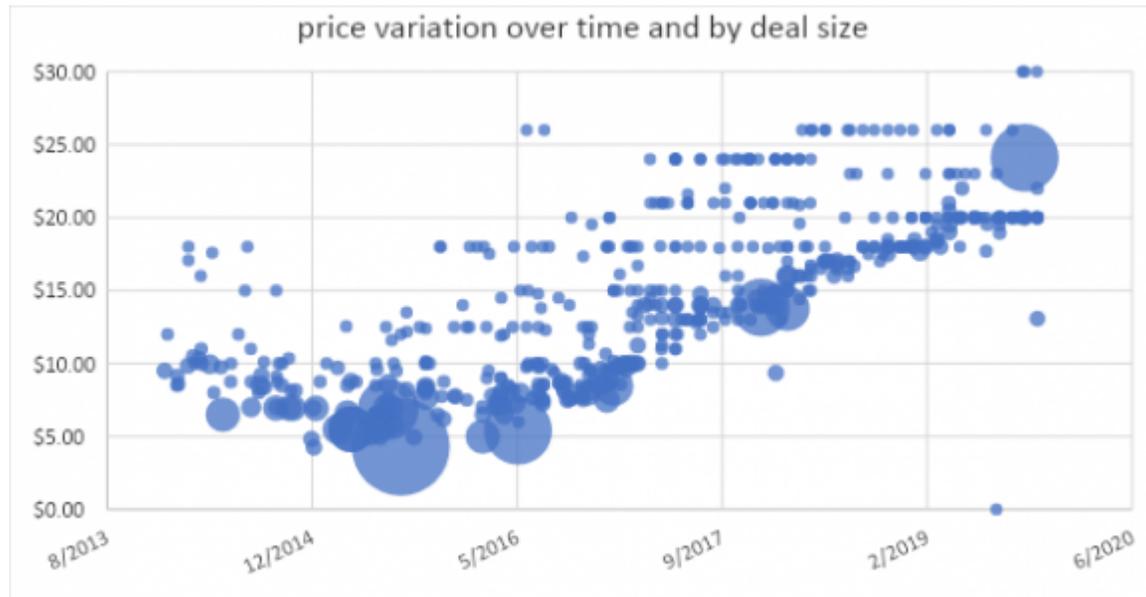
<https://ipv4.potaroo.net/plotend.png>

Why not make a market in IPv4 addresses?



- People have.
- 90% of sales are to CDNs and large social media sites.
- The largest blocks have already been sold; increasingly, the blocks that remain are small ones, which can be difficult to manage.

Sure, but it's time to sell, not to buy



<http://ipv4marketgroup.com/ipv4-pricing/>

<https://www.networkworld.com/article/3191503/internet/mit-selling-8-million-coveted-ipv4-addresses-amazon-a-buyer.html>

- And then there's the price...
- ISC recently sold a /15 at \$14/address.
 - $14 * 2^{15} = \$458,752$
- AWS recently purchased half of MIT's address space at (reportedly) \$20/address
 - $\$20 * 2^{24} / 2 = \$16.8M$
 - MIT using it to fund IPv6 deployment
 - Amazon using it to hold ground while deploying IPv6
- Now apparently about \$20-25/address depending on purchase prefix size



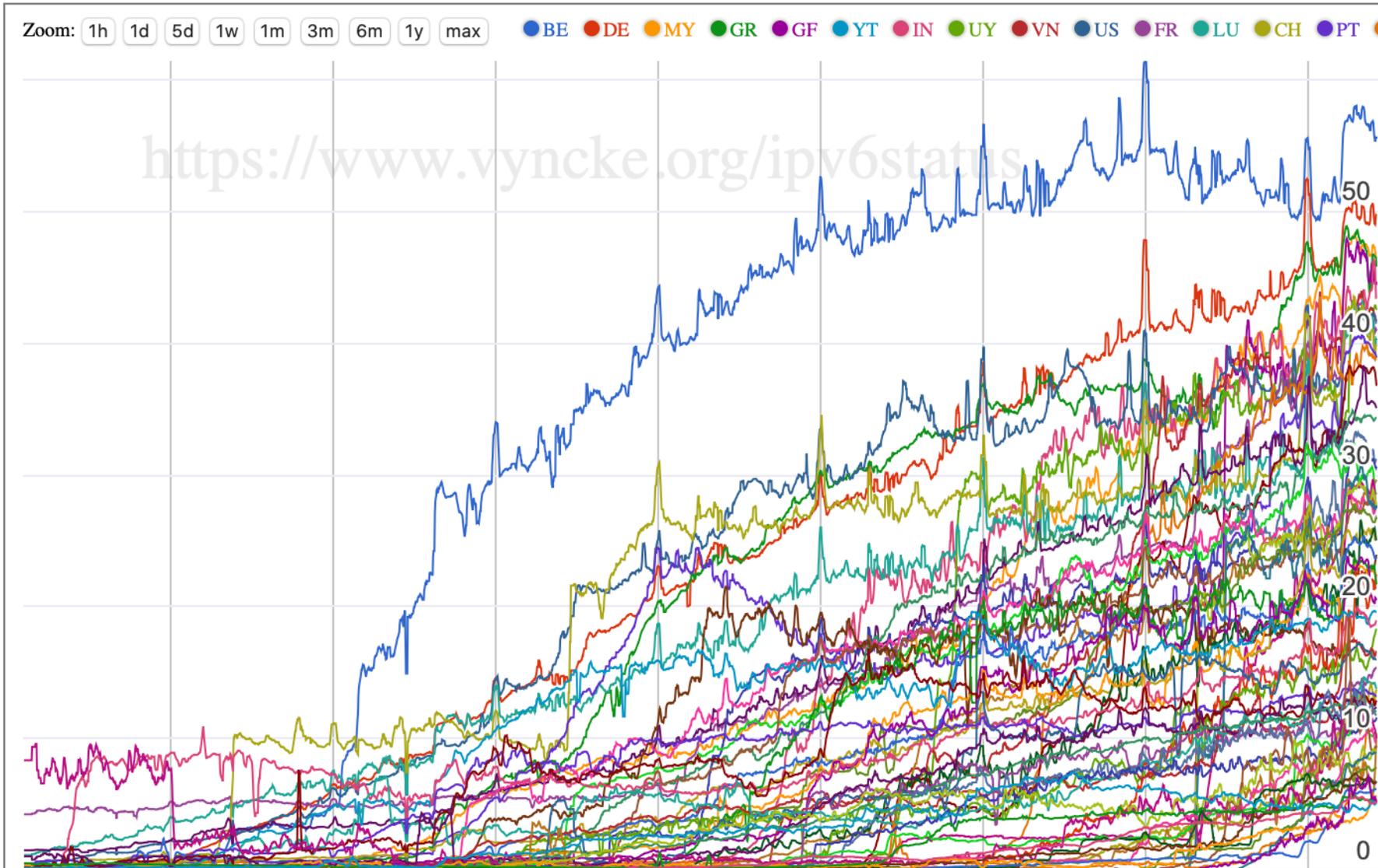
Use in IETF Internet Drafts (June 5 2020)^{I E T F}

- I think it is fair to say that of 1728 current internet drafts,
 - 704 mention IPv6 and
 - 493 mention IPv4.
 - Many Internet Drafts are at layers other than the IP layer and don't mention either by name
- Getting graphics and examples in IPv6 remains a challenge. We're getting there, though, and IPv6 remains a central theme.
- The big deployment challenge is enterprise networks...

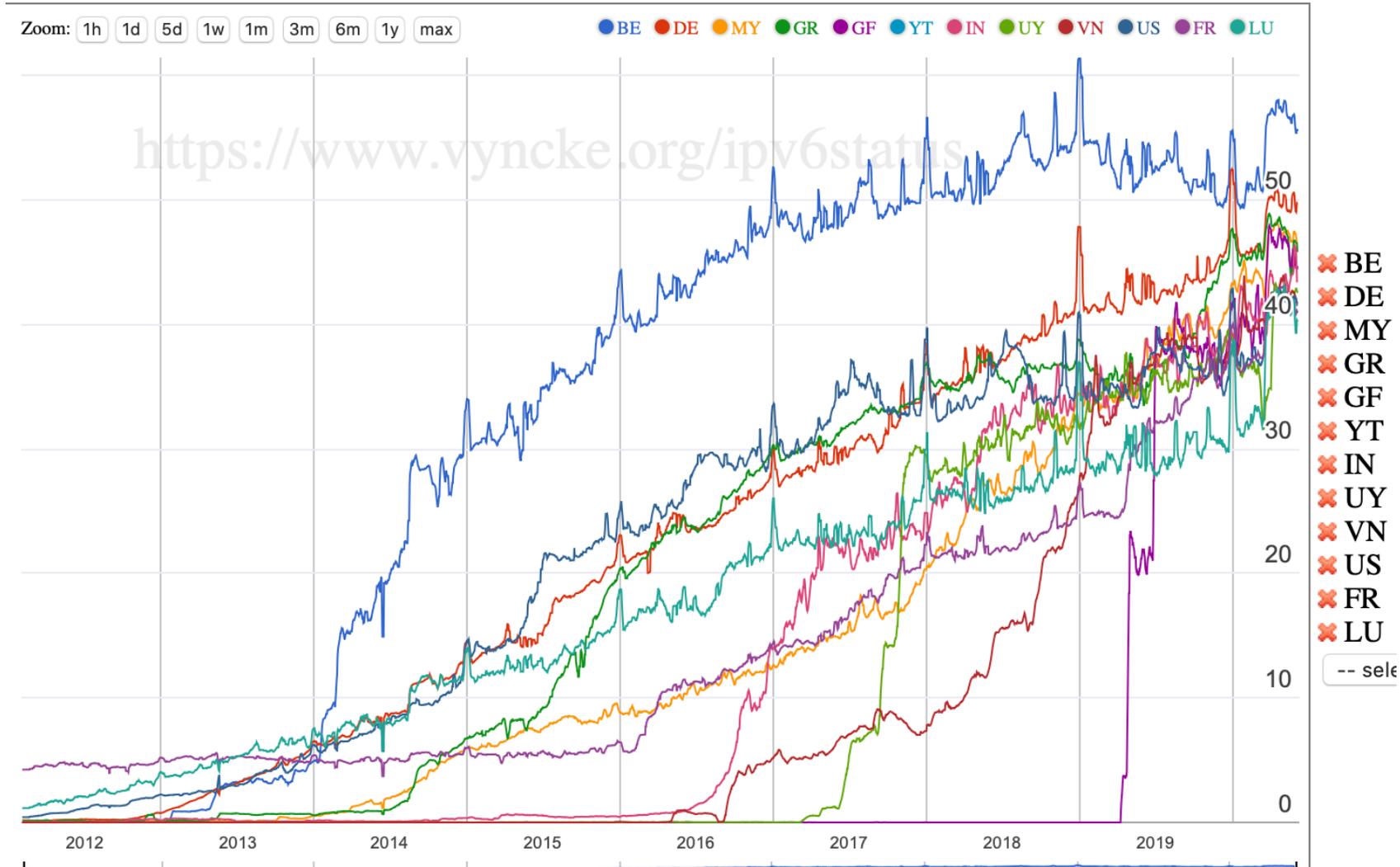
Usage statistics

- There are a number of statistical sources, but the most common ones are probably Google, Akamai, and APNIC
- Differences:
 - Google reports http/s requests to it using IPv4 and IPv6
 - Google is often a CDN and tells us about the last mile network
 - Akamai reports file downloads using IPv4/IPv6
 - Akamai is often a CDN and tells us about the last mile network
 - APNIC uses a google advertisement with three links:
 - One only uses IPv4 (tells that the site is supported end to end at all)
 - One only uses IPv6 (tells that the site is **IPv6 Capable** *and* is supported end to end using IPv6)
 - One has both address formats; the one the user chooses is interpreted to be the one s/he **prefers** *and* is supported end to end using IPv6
 - APNIC has no CDN; these requests tell about end-to-end connectivity across the backbone

69 countries show 5% or more IPv6 traffic (Google)



12 countries show 40% or more IPv6 traffic (Google)



10 countries in Latin America above 5% of traffic (Google)

