



# Update on TLS SNI and IPv6 client adoption

IETF 101 London - MAPRG  
March 20, 2018

**Presenter:** Erik Nygren, <[nygren@akamai.com](mailto:nygren@akamai.com)>



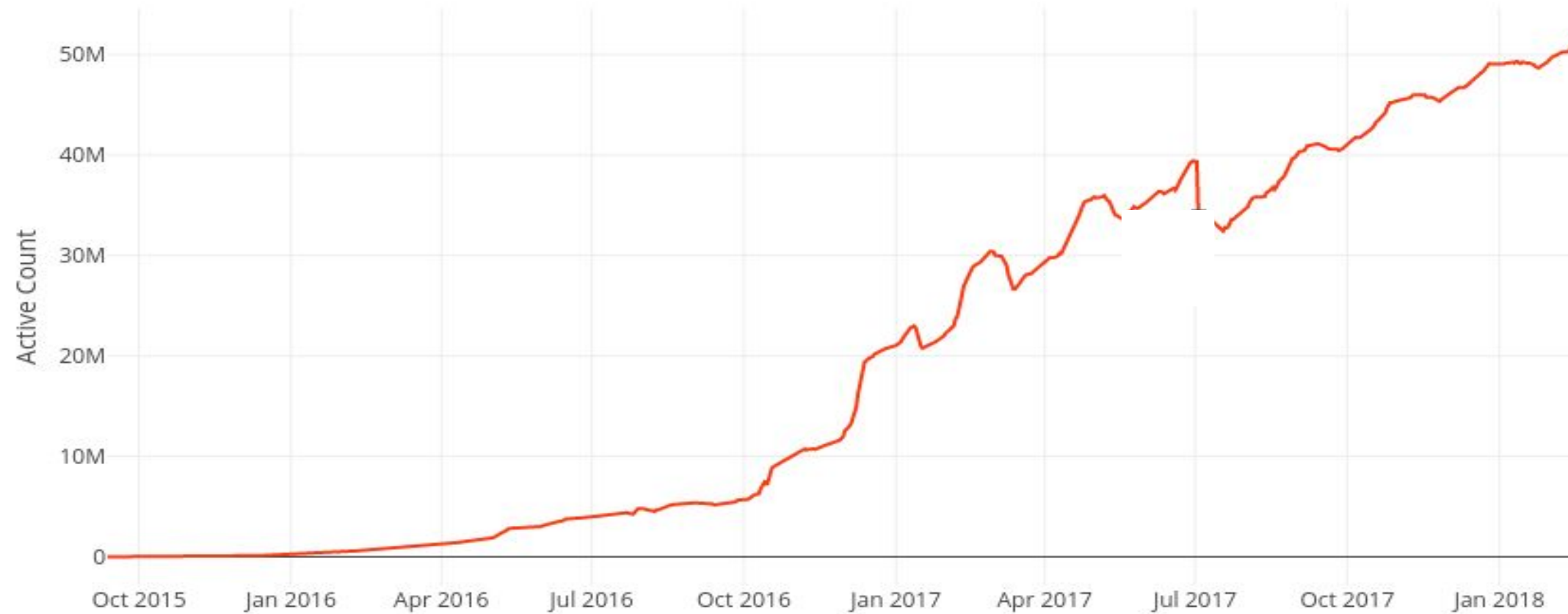
# HTTPS Growth

## Motivation

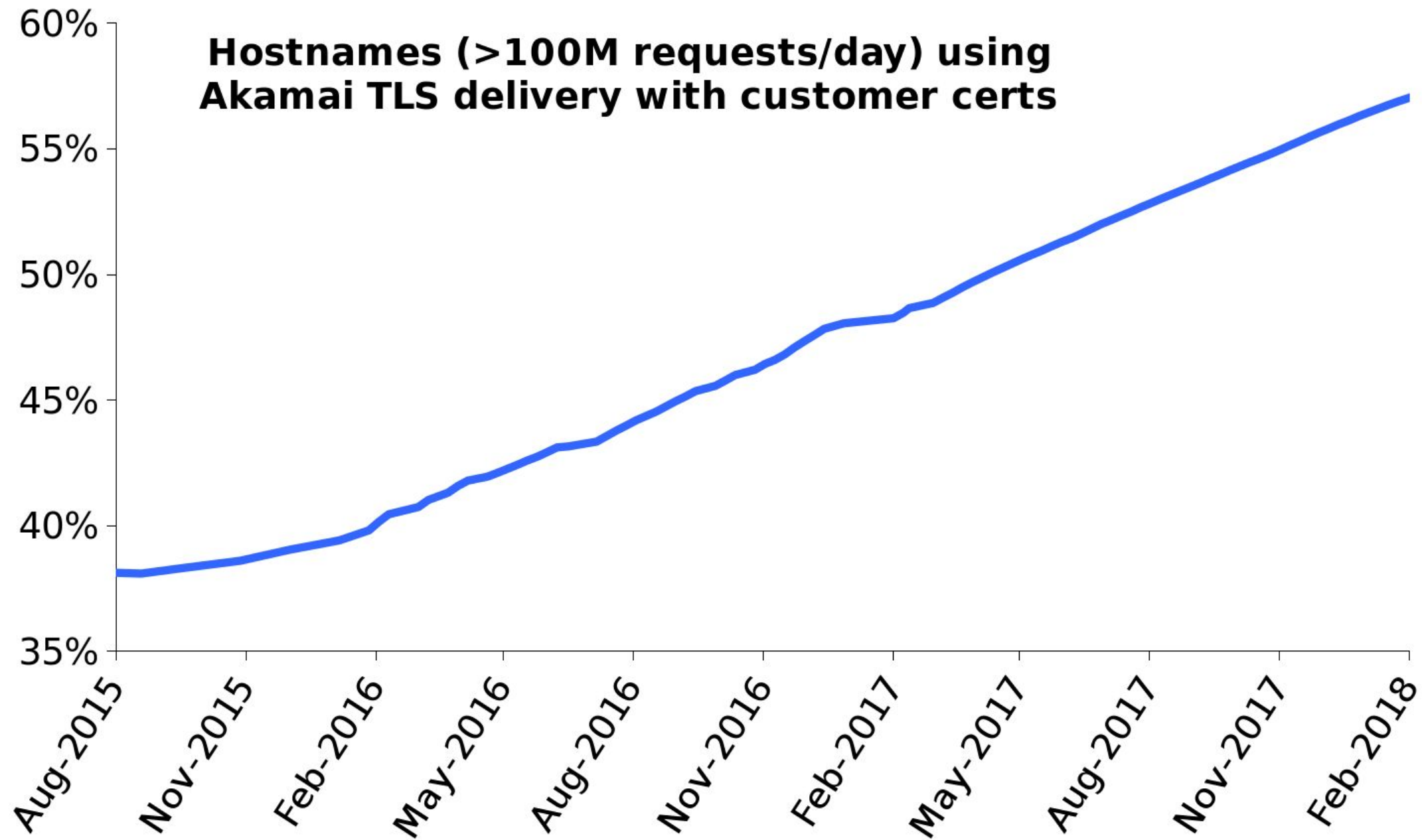
- HTTPS is growing rapidly but no IP multi-tenancy without TLS SNI
  - No indication of cert needed in TLS handshake without SNI
- IPv4 is exhausted at RIRs, but IPv6 still has a ways to go
- TLS SNI adoption was too low as a general solution until recently

# HTTPS growth: from LetsEncrypt

- LetsEncrypt has 50M certs  $\Rightarrow$  equivalent of 3 /8's of IPv4 addresses
  - (TLS SNI and IPv6 are only sustainable ways forward)



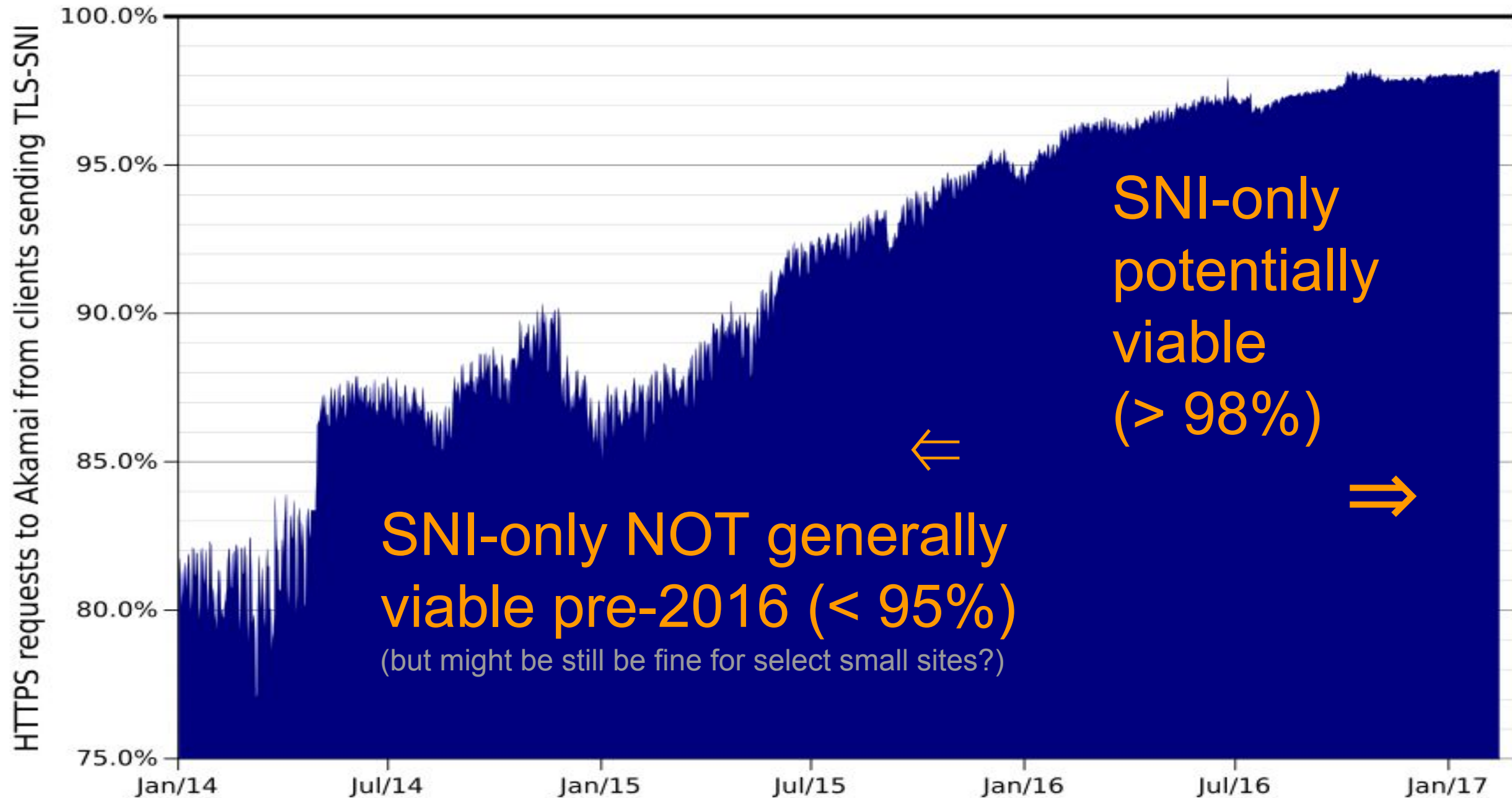
# HTTPS transition of hostnames on Akamai over 3 years





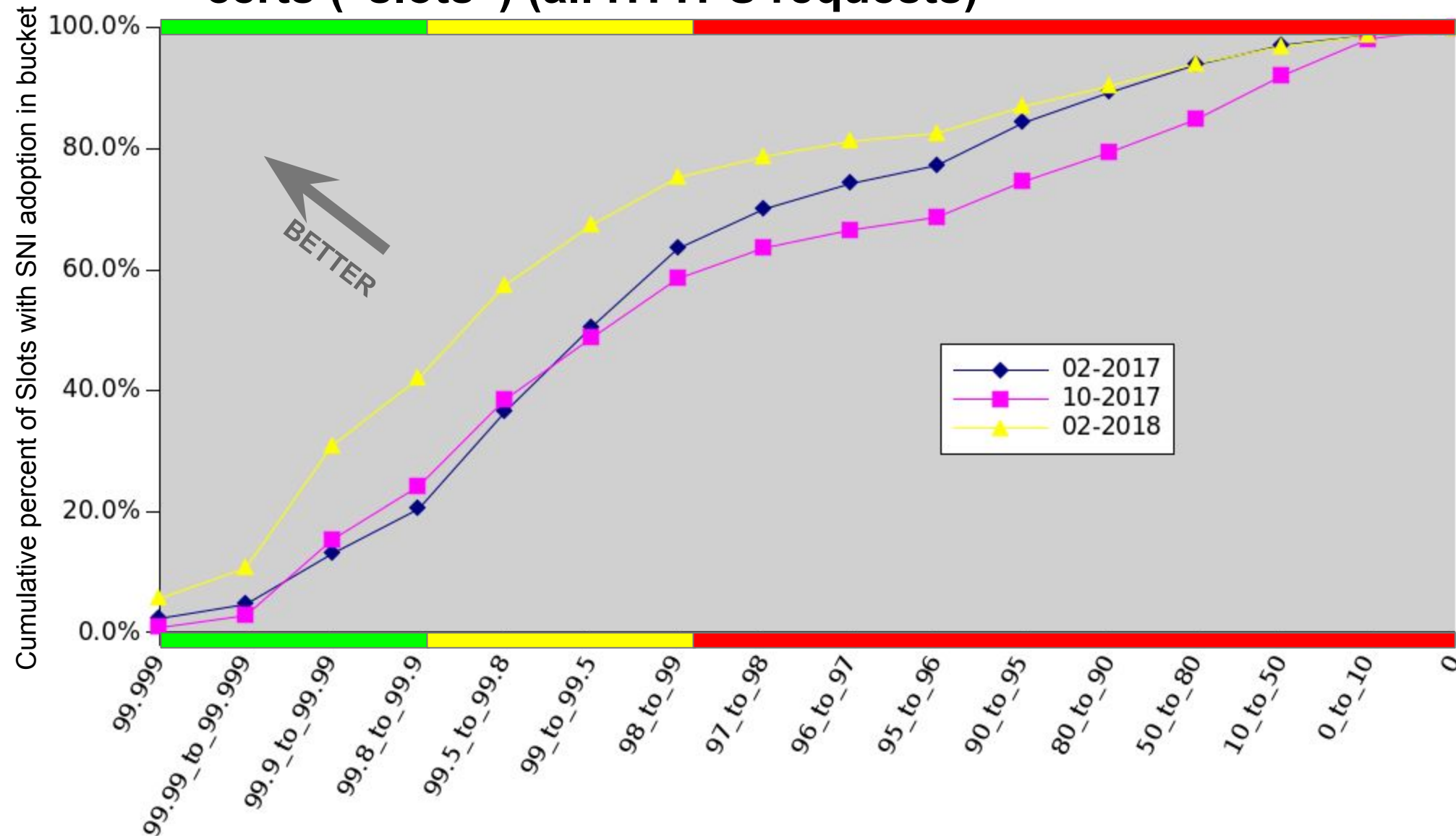
# TLS SNI Trends

# TLS SNI adoption: backstory on Non-SNI traffic



# CDF of SNI usage on Akamai VIP-based customer certs (“slots”)

## SNI adoption by number of VIP-based customer certs (“slots”) (all HTTPS requests)



31% of slots have SNI adoption over 99.9% (but 21% of slots below 97%)

Each line looks at ~8 Trillion HTTPS requests over the course of a week.



## SNI adoption variation by country

- **No longer much global variation in Medians!**
  - (Past results had showed lower SNI usage in some countries)
- Median customer slot over 99.7% almost all geo-regions (99.76% globally)
- Median customer slot near/past 99.9% in many countries
- Lower median in China was fixed Fall 2017 (much was due to one search engine)
- For reference/context, median customer slot TLS 1.2+ usage is lower at 99.14%
  - Many TLS 1.0 clients do send TLS SNI, but some TLS 1.2 clients do not

## What doesn't send TLS SNI?

- Custom clients and apps (eg, gaming consoles & anti-virus apps)
  - Tend to be customer-specific (ie, do not hold back general SNI usage)
- Spoofed User-Agents & MitM (eg, Anti-Virus, SWG) next top offenders\*
- Windows XP now less than 6% of non-SNI traffic\*
- Older Python & older Java/Apache-HttpClient around 4% of non-SNI\*
- Almost all major search bots now have SNI support
  - Only one smaller Chinese search engine remains
- Very long tail of others...
  - Anecdotally, some are getting fixed (eg, ApacheBench)

*\* on slots with > 98% SNI*



# IPv6 Trends

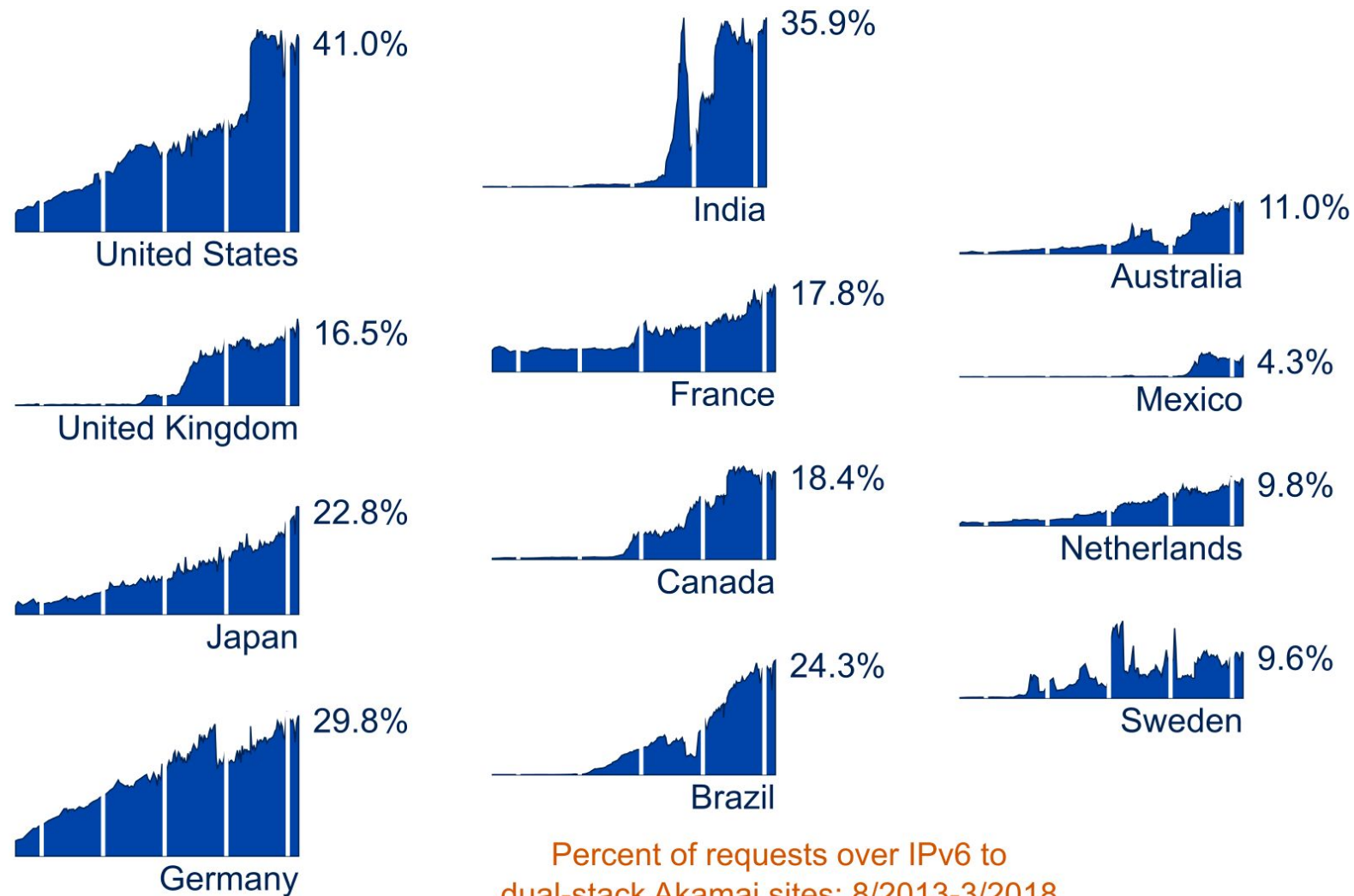
- Methodology: analyze 24-hour snapshots weekly (Wednesdays)
  - Data set contains a few hundred billion HTTP(S) requests against dual-stacked web sites
  - Looking at “IPv6 hits / Total hits”

## Moving the needle? (of global average in 17% to 31% range)

- Approach: look at areas with top residual IPv4 traffic
- Two clusters:
  - IPv6 deployments already in-progress (tend to be on-top)
  - Little-to-no IPv6 deployed yet
- Heavily influenced by which ISPs/networks have deployed IPv6
- Exact percentages sensitive to content mix

# Moving the needle: Countries with top residual IPv4

## High IPv6 (and still significant opportunity)



## Very limited IPv6 (< 3%)

(all below top-10 with IPv6)

- Russia
- China
- Italy
- Spain
- Indonesia
- Turkey
- South Korea

## Moving the needle: Devices (vs. global average in 17% to 31% range)

<b>High IPv6 (but still opportunities)</b> [ with current approx. IPv6 pref. ]	<b>Very limited IPv6</b>
<ul style="list-style-type: none"><li>● Apple iOS 11 [ 28% ]</li><li>● Windows 10 [ 17% ]</li><li>● Windows 7/8.1 [ 9% ]</li><li>● Android 7 [ 29% ]</li><li>● Android 6 [ 25% ]</li><li>● Mac OS X 10.13 [ 24% ]</li></ul>	<ul style="list-style-type: none"><li>● Some streaming set-top boxes</li><li>● Custom apps</li></ul>

## Not getting stuck: Residual IPv4 by network

- **Need to also get more IPv6 movement in the longer tail to keep global IPv6 adoption moving**
- Top ~55 networks are 50% of residual IPv4 and 54% have IPv6 > 2%
- ~360 networks are 80% of residual IPv4 but 31% have IPv6 > 2%
- ~1200 networks are 90% of residual IPv4 but 18% have IPv6 > 2%
- But... IPv6 working on Akamai servers around the world in:
  - 114 countries, 2200+ locations, 840+ networks
  - Many networks have IPv6 on their backbone but not to end-users

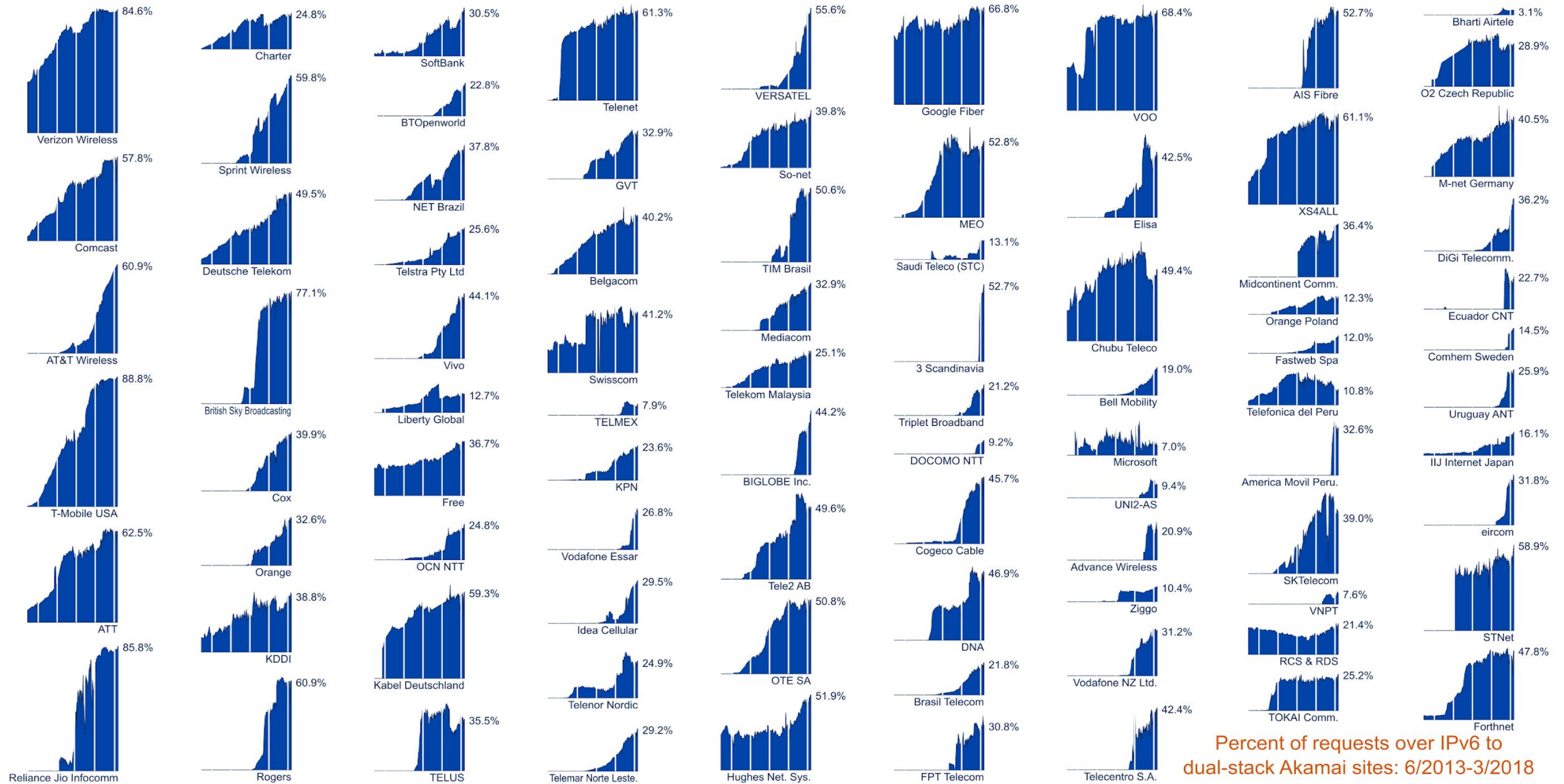
## Learning more

- **TLS SNI:** <https://bit.ly/2pbTWXF> <https://bit.ly/2FmBraG>
- **IPv6:** <https://akamai.com/ipv6>
- Questions?
  - Erik Nygren <nygren@akamai.com>



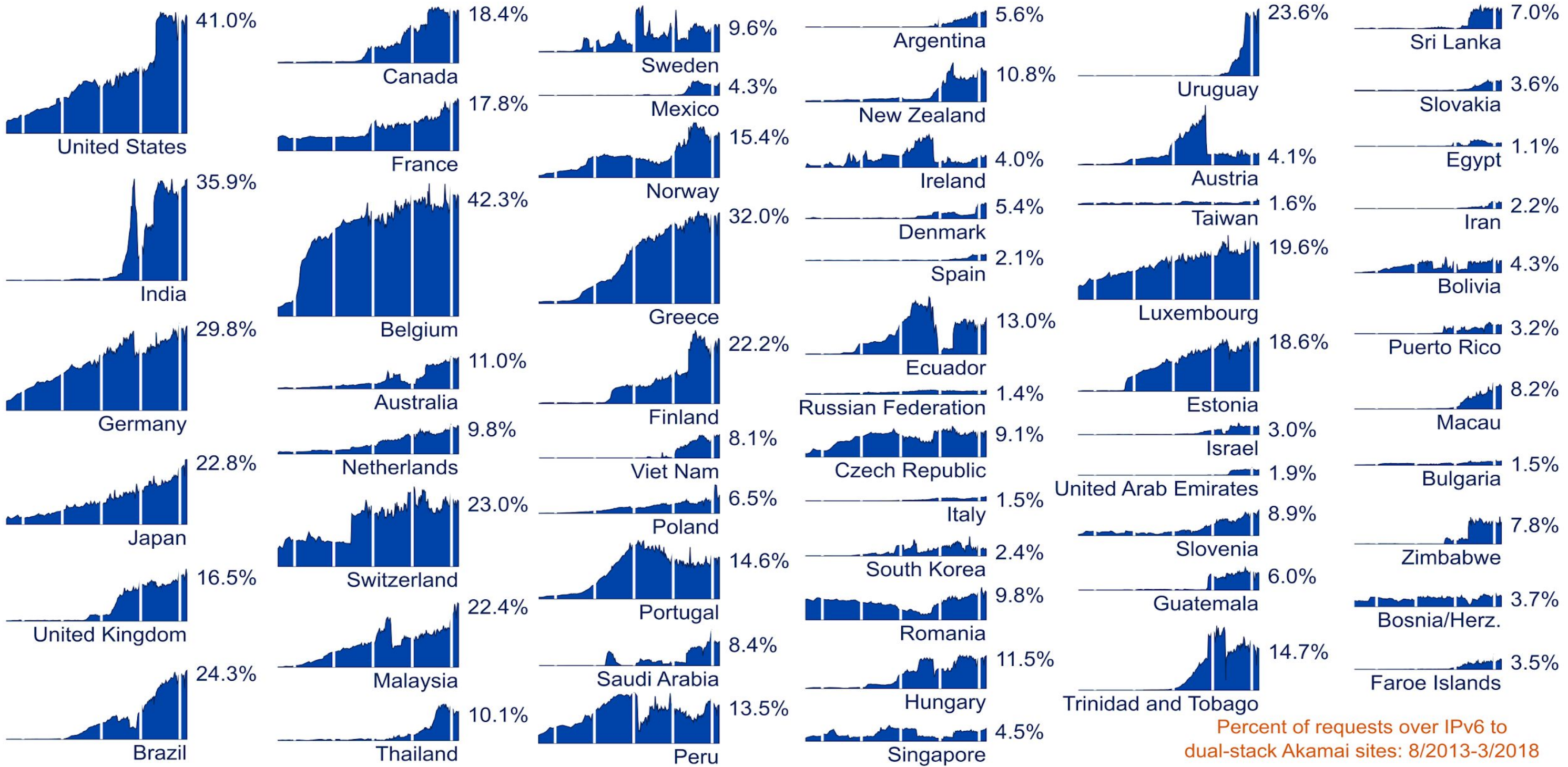
# SUPPORT / BACKGROUND

# Five years of IPv6 growth by network (top nets by IPv6)



Percent of requests over IPv6 to dual-stack Akamai sites: 6/2013-3/2018

# Five years of IPv6 growth by country



Percent of requests over IPv6 to dual-stack Akamai sites: 8/2013-3/2018