Update on TLS SNI and IPv6 client adoption

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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 ⇒ equivalent of 3 /8’s of IPv4 addresses
  - (TLS SNI and IPv6 are only sustainable ways forward)

Source: https://letsencrypt.org/stats/
HTTPS transition of hostnames on Akamai over 3 years

TLS SNI Trends
TLS SNI adoption: backstory on Non-SNI traffic

SNI-only NOT generally viable pre-2016 (< 95%)
(but might be still be fine for select small sites?)

SNI-only potentially viable (> 98%)
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)

<table>
<thead>
<tr>
<th>Country</th>
<th>Percent IPv6</th>
</tr>
</thead>
<tbody>
<tr>
<td>United States</td>
<td>41.0%</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>16.5%</td>
</tr>
<tr>
<td>Japan</td>
<td>22.8%</td>
</tr>
<tr>
<td>Germany</td>
<td>29.8%</td>
</tr>
<tr>
<td>India</td>
<td>35.9%</td>
</tr>
<tr>
<td>Canada</td>
<td>18.4%</td>
</tr>
<tr>
<td>Brazil</td>
<td>24.3%</td>
</tr>
</tbody>
</table>

### Very limited IPv6 (< 3%)

(all below top-10 with IPv6)

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

Percent of requests over IPv6 to dual-stack Akamai sites: 8/2013-3/2018
Moving the needle: Devices (vs. global average in 17% to 31% range)

<table>
<thead>
<tr>
<th>High IPv6 (but still opportunities)</th>
<th>Very limited IPv6</th>
</tr>
</thead>
<tbody>
<tr>
<td>[ with current approx. IPv6 pref. ]</td>
<td></td>
</tr>
<tr>
<td>● Apple iOS 11 [ 28% ]</td>
<td>● Some streaming set-top boxes</td>
</tr>
<tr>
<td>● Windows 10 [ 17% ]</td>
<td>● Custom apps</td>
</tr>
<tr>
<td>● Windows 7/8.1 [ 9% ]</td>
<td></td>
</tr>
<tr>
<td>● Android 7 [ 29% ]</td>
<td></td>
</tr>
<tr>
<td>● Android 6 [ 25% ]</td>
<td></td>
</tr>
<tr>
<td>● Mac OS X 10.13 [ 24% ]</td>
<td></td>
</tr>
</tbody>
</table>
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


- **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