Update on TLS SNI and IPv6 client adoption
March 20, 2018

Presenter:  Erik Nygren, <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 ⇒ 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

Hostnames (>100M requests/day) using Akamai TLS delivery with customer certs

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%)
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)

<table>
<thead>
<tr>
<th>Country</th>
<th>Percent of requests over IPv6 to dual-stack Akamai sites</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>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>
</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) [ with current approx. IPv6 pref. ]</th>
<th>Very limited IPv6</th>
</tr>
</thead>
<tbody>
<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>
Learning more


● IPv6:  https://akamai.com/ipv6

● Questions?
  ○ Erik Nygren <nygren@akamai.com>
SUPPORT / BACKGROUND
Five years of IPv6 growth by country

- United States: 41.0%
- Canada: 18.4%
- Sweden: 9.6%
- Argentina: 5.6%
- Uruguay: 23.6%
- Sri Lanka: 7.0%
- Mexico: 4.3%
- New Zealand: 10.8%
- Switzerland: 23.0%
- Austria: 4.1%
- Estonia: 3.0%
- Japan: 29.8%
- France: 42.3%
- Norway: 32.0%
- Ireland: 5.4%
- Taiwan: 19.6%
- Slovakia: 3.6%
- India: 35.9%
- Belgium: 11.0%
- Denmark: 2.1%
- Austria: 1.6%
- Iran: 2.2%
- Germany: 29.8%
- Greece: 22.2%
- Finland: 8.1%
- Spain: 2.1%
- Iran: 2.2%
- Australia: 9.8%
- Russian Federation: 1.4%
- Czech Republic: 9.1%
- United Arab Emirates: 8.9%
- Macau: 8.2%
- Netherlands: 23.0%
- Viet Nam: 6.5%
- Italy: 1.5%
- Slovenia: 8.9%
- Portugal: 14.6%
- Poland: 6.5%
- South Korea: 2.4%
- Bulgaria: 1.5%
- Malaysia: 22.4%
- Russia: 8.1%
- Romania: 9.8%
- Bosnia/Herz: 3.7%
- United Kingdom: 16.5%
- Saudi Arabia: 8.4%
- Hungary: 11.5%
- Trinidad and Tobago: 14.7%
- Brazil: 24.3%
- Thailand: 10.1%
- Peru: 4.5%
- Singapore: 4.5%
- Faroe Islands: 3.5%

Percent of requests over IPv6 to dual-stack Akamai sites: 8/2013-3/2018
Five years of IPv6 growth by network

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