No domain left behind:

is Let's Encrypt democratizing encryption?

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Disclaimer

- None of the authors is in any way affiliated with *Let's Encrypt*
- In other words: we do not speak for them
- But if you like their work, you may consider supporting them

The Encryption Rush

Ed Snowden NSA's revelations

- Massive, widespread surveillance
- Worst nightmares came true

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Consequences:

- For many, it was a wake-up call (and panic)
- Market distrust in vendors
- Provided a great momentum for better security

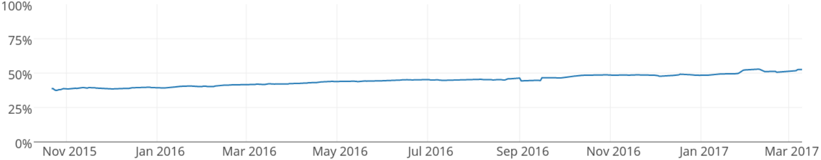
Reactions:

- IETF: RFC 7258, RFC 7624
- iOS/Android: mobile phone encryption by default
- Cloud providers enabling encryption everywhere
- ...

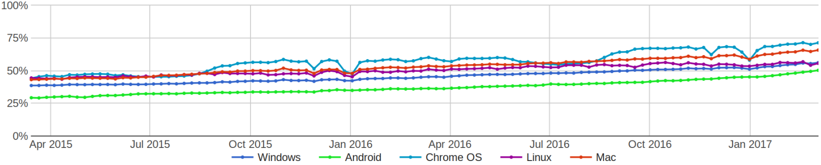
More than half of web traffic is encrypted nowadays

Yet that leaves out a lot of people without HTTPS

Firefox telemetry[1]



Chrome telemetry[2]



[1] https://telemetry.mozilla.org/, based on *Let's Encrypt* stats page

[2] https://www.google.com/transparencyreport/https/metrics/

Certificates are required for encryption on the web

Barriers to ubiquitous web encryption (X.509 cert):

- **Cost**: purchase, deployment and renewal
- **Complexity**: request, deployment (at scale)

Let's Encrypt[3] aims to make encrypted traffic ubiquitous

- Issue and re-issue costs: **$0.00**
- Complexity mitigated by **automation**
  1. ACME protocol[4]
  2. and clients, e.g. Certbot[5]

[3] `https://letsencrypt.org`

[4] draft-ietf-acme-acme-latest → `https://ietf-wg-acme.github.io/acme/`

[5] `https://certbot.eff.org/`

No domain left behind

Is *Let's Encrypt* democratizing encryption?

Research question

"In its first year of certificate issuance,
has Let's Encrypt been successful in democratizing encryption?"

Approach: measurements

- Analyze issuance in the first year of *Let's Encrypt*
- Show adoption trend from various perspectives
- Analyze coverage for the lower-cost end of the market

Methodology

- Period covered: Sept. 2015-2016 (1st year)
- Results based on FQDNs reduced to 2LD/3LD form
  - `a.b.c.d.com` → `d.com`

Datasets

Certificates →	Certificate transparency[6]
Domain to IP mapping →	Farsight DNSDB[7]
Organization mapping →	Methodology from previous work[8], using `whois` data & Maxmind GEOIP2
Registration info →	`.nl` registry (SIDN)

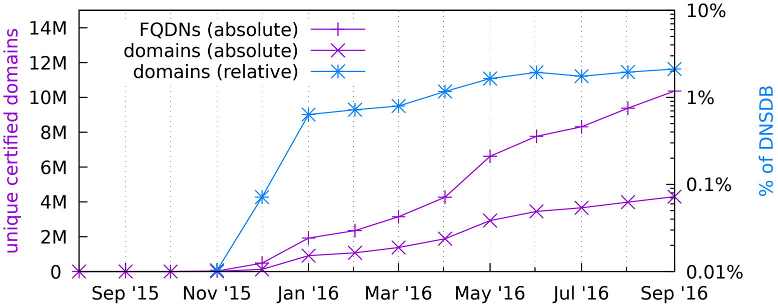
[6] https://www.certificate-transparency.org/known-logs

[7] https://www.dnsdb.info/

[8] S. Tajalizadehkhoob et al., “Apples, oranges and hosting providers: heterogeneity and security in the hosting market,” IEEE NOMS 2016

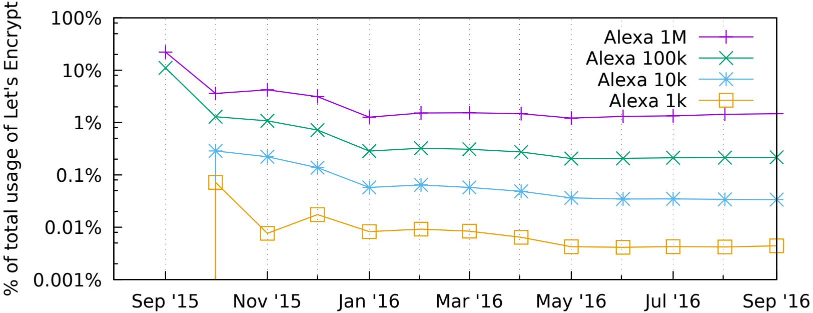
Let's Encrypt Adoption Rate

- Steady growth



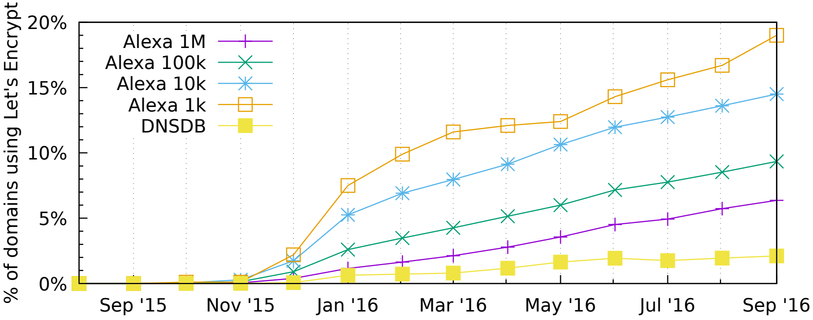
Who's using *Let's Encrypt* ?

- 98% of certificates are issued outside Alexa 1M . . .



Who's using *Let's Encrypt* ?

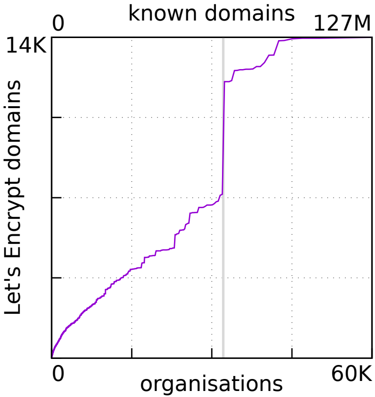
- …yet issuance is not restricted to lower end of the market
  - meaning: big players also use in their subdomains



Growth is attributed to adoption by major players

3 hosting providers are responsible for 47% of the *Let's Encrypt* certified domains

November 2015



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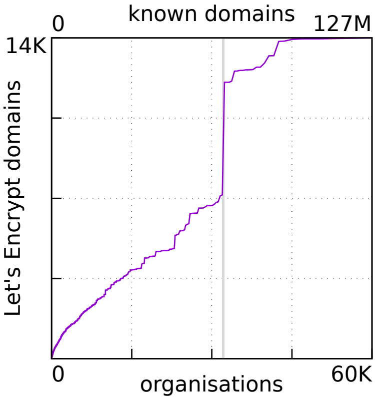

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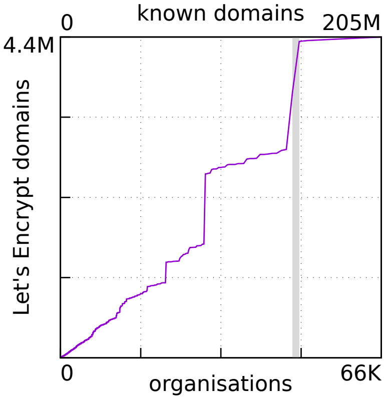

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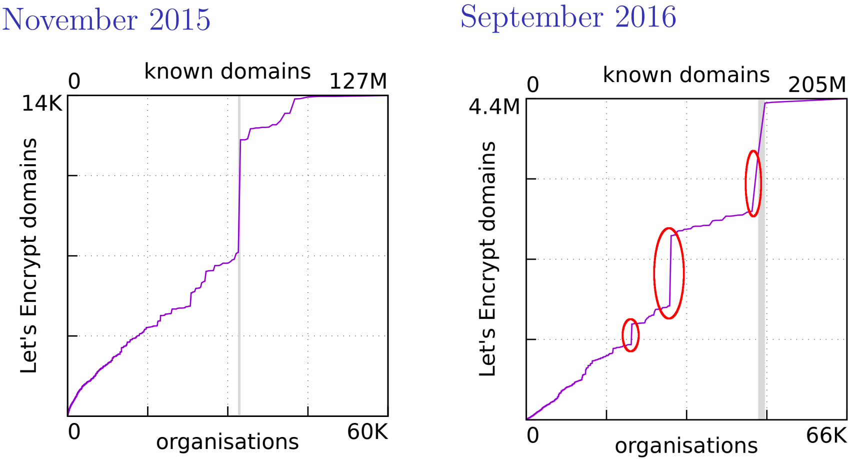


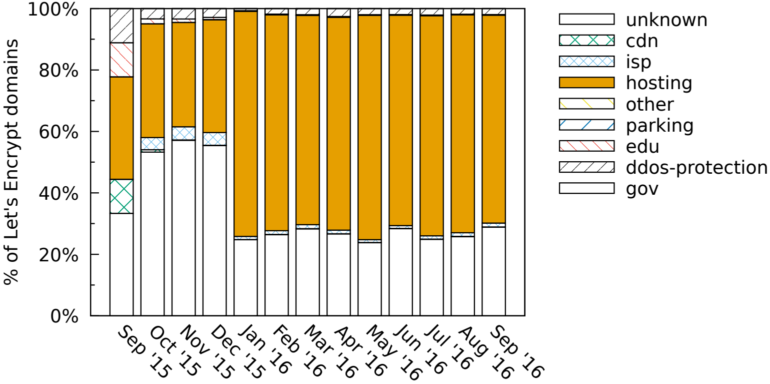
November 2015

September 2016

Automation works!!

Issuance is dominantly for web hosting

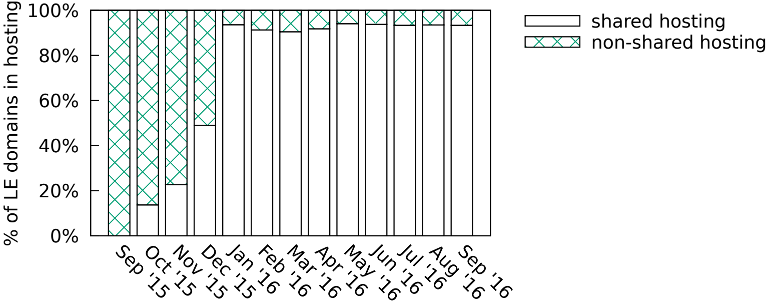
So far, no surprises



Over 90% of domains in hosting are on shared hosting

Issuance is dominantly for the lower-cost end of the market

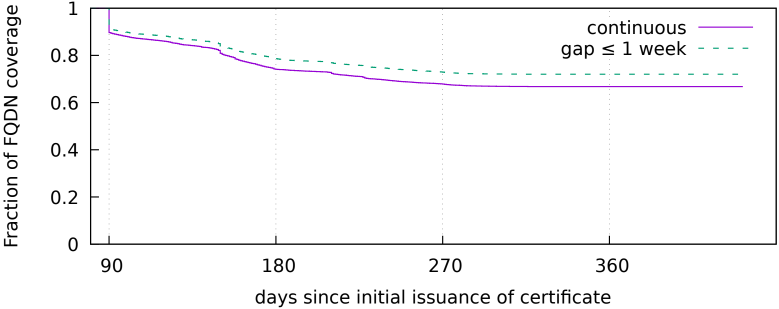
- Shared hosting = 10 domains/IP[9]
- *Let's Encrypt* reaches those with less incentive to encrypt



[9] S. Tajalizadehkhoob et al., "Apples, oranges and hosting providers: heterogeneity and security in the hosting market," IEEE NOMS 2016

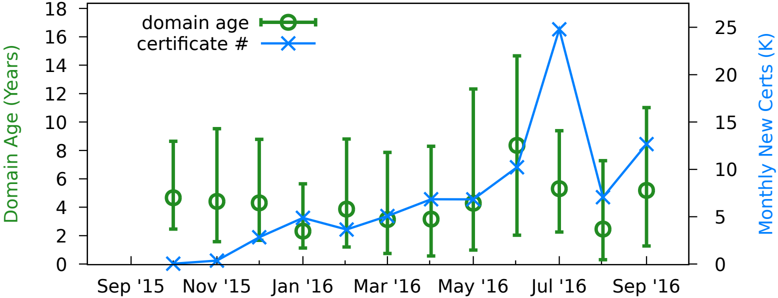
Let's Encrypt certificates are valid for 90 days

The majority of certificates are correctly renewed after their first expiration



Let's Encrypt : domain age use

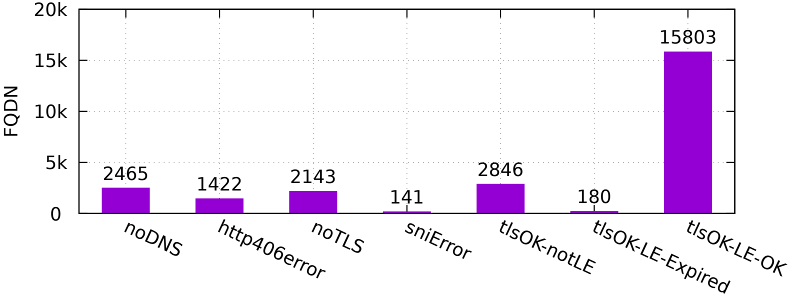
- Case study: `.nl`
- Determine the age of the domain when the cert was issued



Median, Q25, Q75 and number of monthly new certificates for `.nl` domains

Let's Encrypt : deployment

- https scans + cert processing (lower bound)
- 25K randomly chosen *Let's Encrypt* FQDN



Conclusions

We show that

- *Let's Encrypt* has been a success
  - Reduces costs & complexity
- Democratize encryption by covering low cost end of the market (shared hosting)
  - but big players also use it
- Automation works: *Let's Encrypt*'s allows for bulk issuing
  - 3 hosting providers are responsible for 47% of the *Let's Encrypt* certified domains
- The majority of certificates are correctly renewed after their first expiration (90 days)

And find that

Let's Encrypt has indeed started to democratize encryption

Future work

Future work

- extend measurement period
- issued versus deployed
  - active scans on shared hosting require prior knowledge of domains served (SNI)
- use by malicious actors

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Download our paper at:
`https://arxiv.org/abs/1612.03005`