



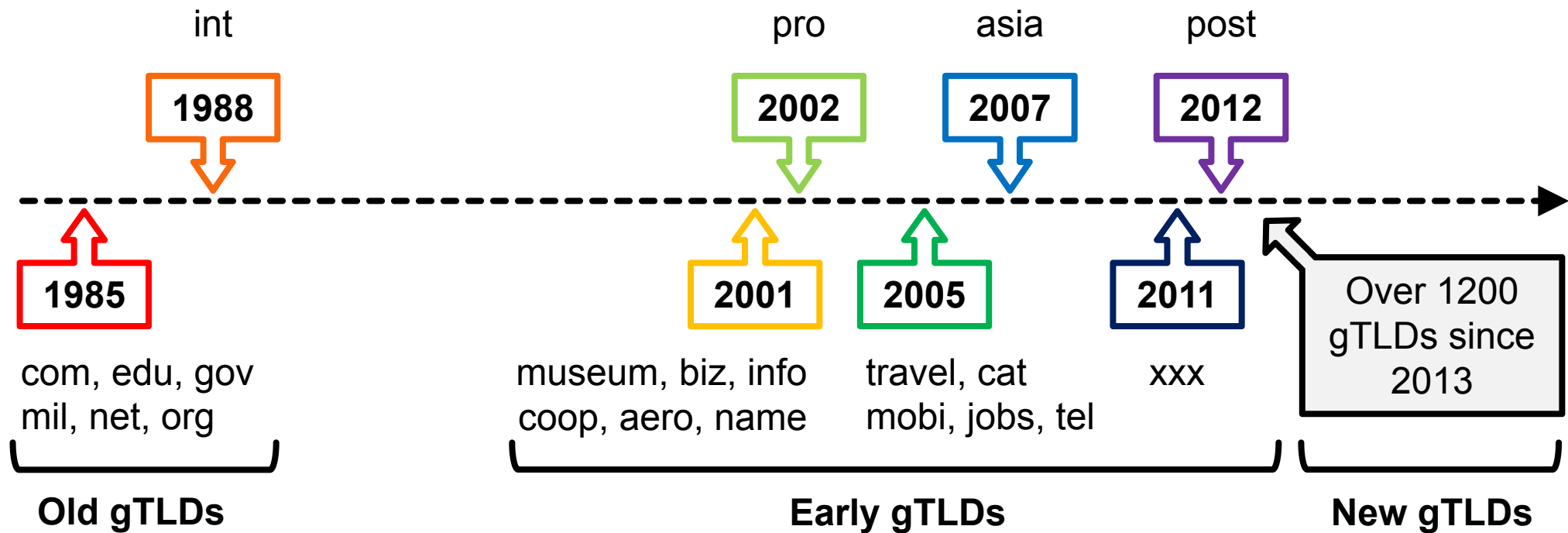
UNDERSTANDING EVOLUTION AND ADOPTION OF TOP LEVEL DOMAINS AND DNSSEC

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INTRODUCTION

- DNS translates human friendly hostnames into IP addresses
 - www.example.com
 - IPV4: 93.184.216.34
 - IPV6: 2606:2800:220:1:248:1893:25c8:1946
- DNSSEC authenticates DNS responses
- ICANN's New gTLD Program expanded DNS by introducing thousands of new gTLDs
- We analyze adoption of new gTLDs and DNSSEC implementation

BACKGROUND



RESEARCH OBJECTIVE

| Authors | Year | Analysis |
|-----------------------------|------|--|
| Jarassriwilai <i>et al.</i> | 2015 | Usage of TLDs and second level domains |
| Halvorson <i>et al.</i> | 2015 | Registrant behavior in new TLDs |
| Chung <i>et al.</i> | 2017 | DNSSEC PKI management |

An empirical longitudinal study on the adoption of new gTLDs and the deployment of DNSSEC in *New Zealand*

DATA COLLECTION



Collect local and national datasets



TLD classification



TLD, DNSSEC analysis



RESULTS



DATASET OVERVIEW

| TLD | 2013 | 2018 | |
|--------------|------------|------------|---|
| Original | 75.077 | 71.239 | ↓ |
| Early | 0.223 | 0.741 | ↑ |
| New | 0.008 | 0.328 | ↑ |
| Country | 24.692 | 27.693 | ↑ |
| Total | 100 | 100 | |

TOP 10 MOST QUERIED TLDS

| Rank | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 |
|------|------|------|------|------|------|------|
| 1 | com | | | | | |
| 2 | net | | | | | |
| 3 | nz | | | | | |
| 4 | arpa | org | arpa | arpa | sk | sk |
| 5 | org | arpa | org | org | arpa | arpa |
| 6 | cn | cn | cn | cn | org | org |
| 7 | au | info | uk | au | cn | cn |
| 8 | ru | au | au | cz | au | au |
| 9 | uk | uk | edu | uk | io | io |
| 10 | edu | edu | de | de | be | info |

TLD USAGE (1)

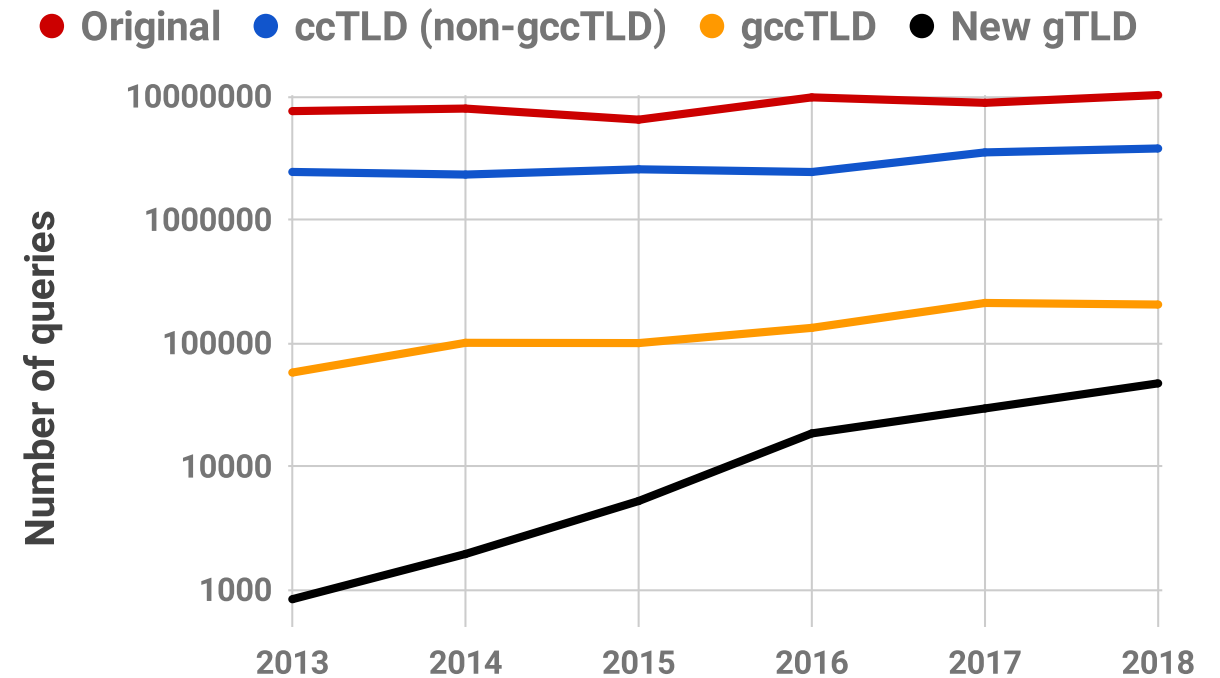
- Machine generated DNS requests
 - .sk ccTLD was 4th in requests in 2017 and 2018
 - Over 99% of the .sk DNS requests were to ESET, a cybersecurity company headquartered in Slovakia
 - FQDNs were mostly non human-friendly with a median length of 123 alphanumeric characters
- TLD growth may not be entirely human-driven

TLD USAGE (2)

- Unintended TLD uses
 - ccTLDs that are open to non-citizens could be used as gTLDs instead
 - .io ccTLD was top 10 in requests in 2017 and 2018
 - Generic country code (gcc) TLD classification by Google
- Domain hack
 - youtu.be as link shortener for YouTube
- Static TLD classifications may become outdated

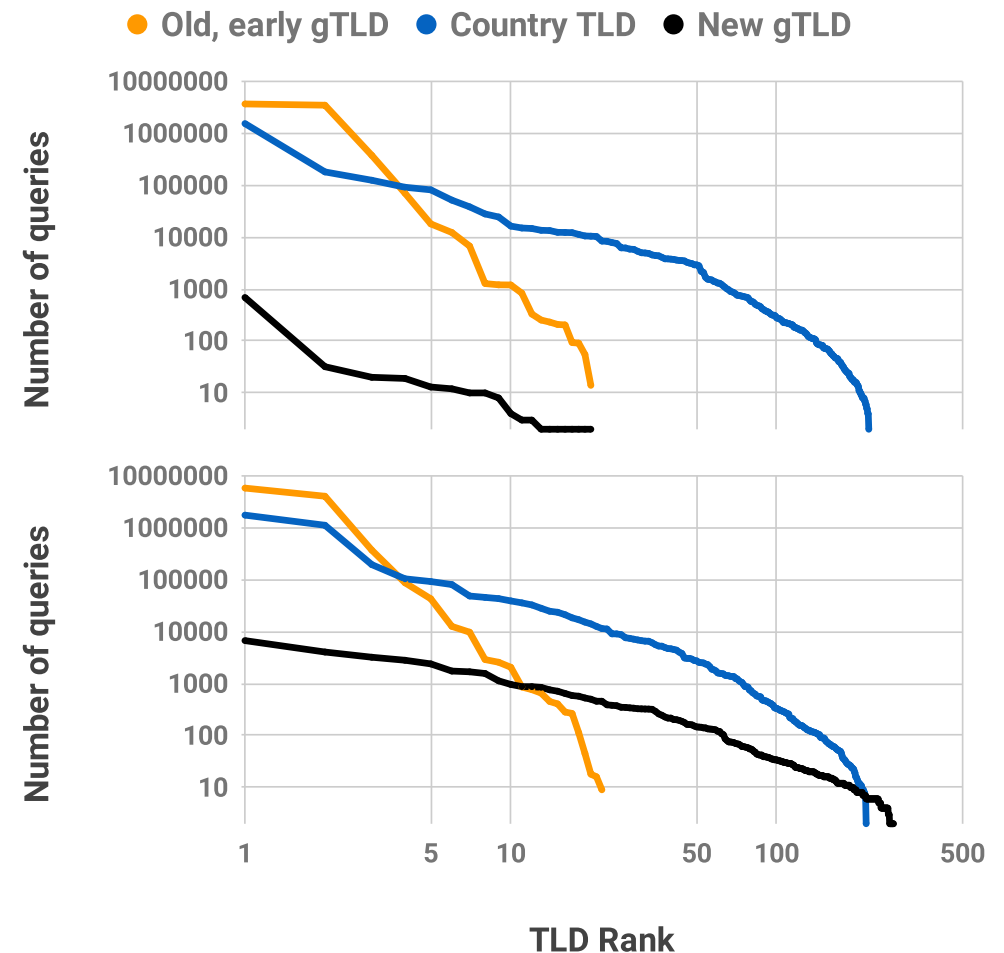
TLD GROWTH

- Number of new gTLDs queried grew from 20 to 361 from 2013 to 2018
- CAGR over 5 year period:
 - New gTLDs (124%)
 - Generic ccTLDs (29%)
 - Non-generic ccTLDs (9%)
 - Original gTLDs (6%)



TLD POPULARITY CONCENTRATION

- Minimal change in old, early gTLDs and ccTLDs
- Zipf's law in non-new gTLDs
- Weak popularity concentration in new gTLDs
- Top 10% of domains:
 - 77% of queries for new gTLDs
 - 95% of queries for other TLDs

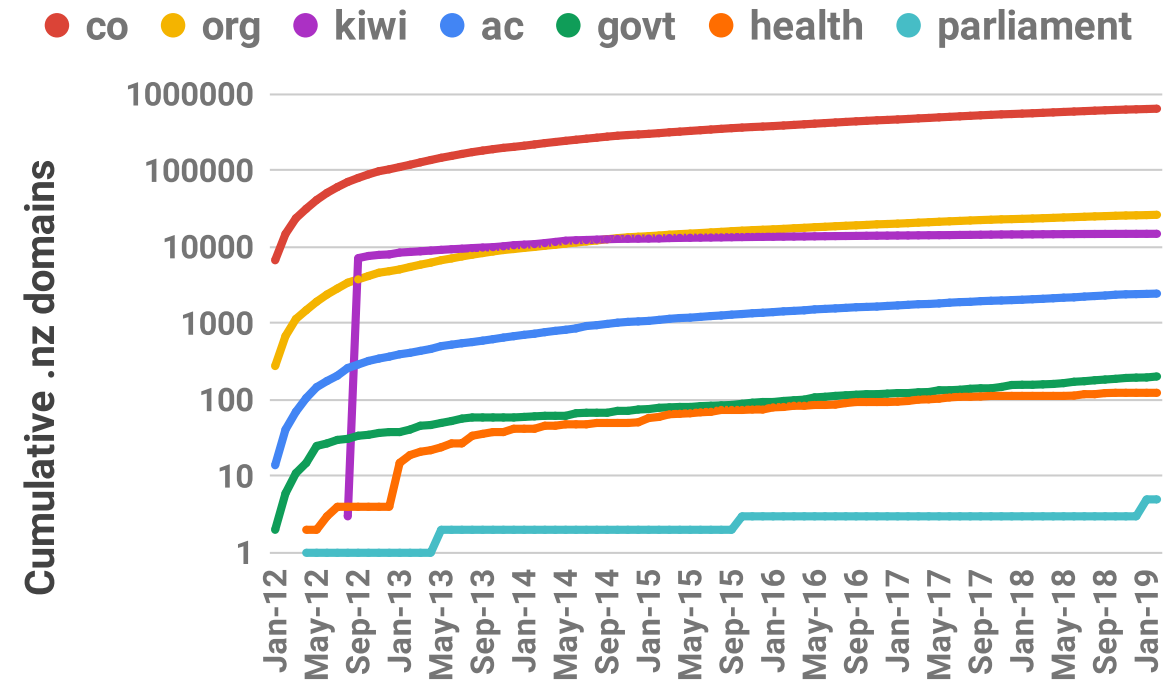


SECOND LEVEL DOMAINS (2LD)

- www.google.co.nz
- InternetNZ manages the .nz ccTLD and its second level domain names
- 2LD registration opened to public registration in 2014 similar to ICANN's New gTLD Program
- www.google.(any name).nz
- New 2LDs account for over 20% of all newly created domains since September 2014
- 0.6% of total requests were to new 2LDs

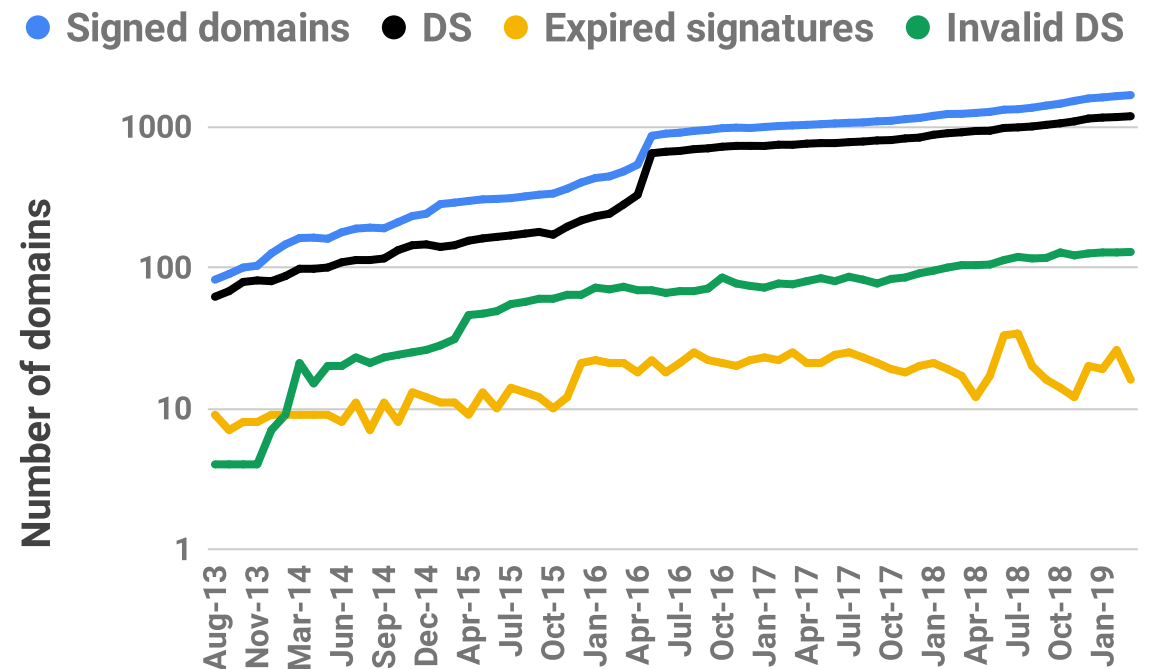
TLD AND 2LD

- Opening registration of both gTLDs and 2LDs could lead to overlapping domain names
- TLD .kiwi and 2LD .kiwi.nz
- Unusually high number of .kiwi.nz domains were registered immediately upon release
- Domain squatting



DNSSEC OVERVIEW (.NZ DOMAIN)

- Jump in DS records and signed domains in 2016
- Insecure delegations are slowly growing
- Expired signatures are decreasing in proportion
- Invalid DS records are high, with little signs of improvement





TAKEAWAYS



DOMAIN NAMES

- Adoption of new gTLDs is growing rapidly
- New gTLDs are not very popular overall
- Lower popularity concentration in new gTLDs
- gTLD adoption is still evolving
- New 2LDs under the .nz ccTLD are relatively more often queried than new gTLDs
- No guidelines for handling overlap between gTLDs and 2LDs

DNSSEC

- DNSSEC implementation is growing in New Zealand but still incomplete
- Third party DNS operators can play a key role in encouraging DNSSEC deployment
- Domains with DS records are growing at a slower rate than the number of signed domains
- Less than 1% of domains have expired signatures
- 10% of domains have incorrect DS records

CONCLUDING REMARKS

- Presented a longitudinal analysis on the adoption of new gTLDs and the deployment of DNSSEC in New Zealand
- New gTLDs are growing in popularity
- DNSSEC implementation is improving but still incomplete
- Need to explore the TLD topic further before ICANN's second round of new gTLD applications