Measuring DNSSEC Deployments
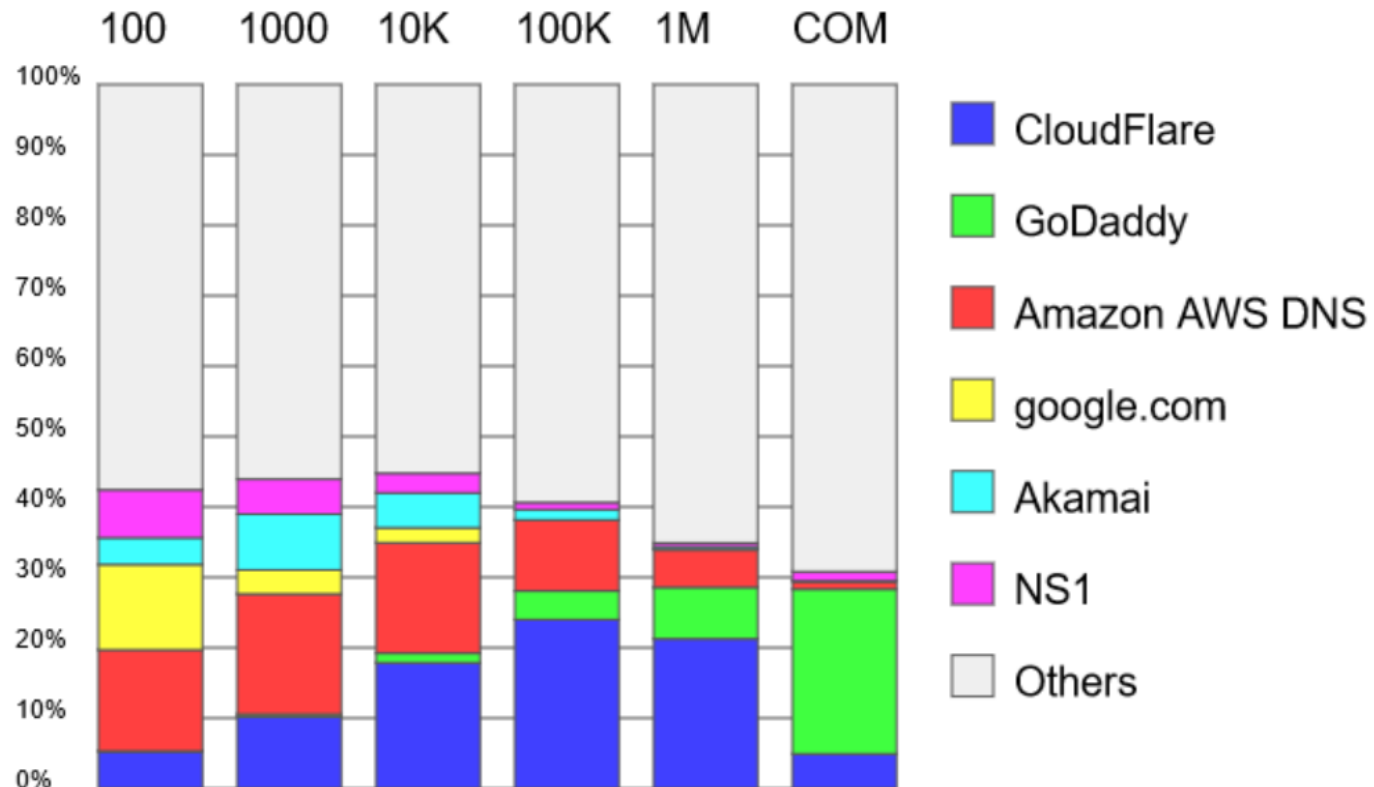
Christian Huitema, Alain Durand

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# DNSSEC Deployment in Second Level Domains

- Is There Variability of DNSSEC Deployment in SLDs per **DNS Provider**?

- Is there Variability of DNSSEC Deployment in SLDs per **TLD**?

Concentration of Authoritative DNS Hosters, August 2023

- **GoDaddy serves largest share of the COM Zone**
  - And some of the top 1M as well
- **Cloudflare and AWS serve largest shares of "middle size" domains**
- **Cumulative share of big DNS Hosters never exceeds 50%**

DNSSEC Deployments, August 2023

Source: https://ithi.research.icann.org/graph-m11.html
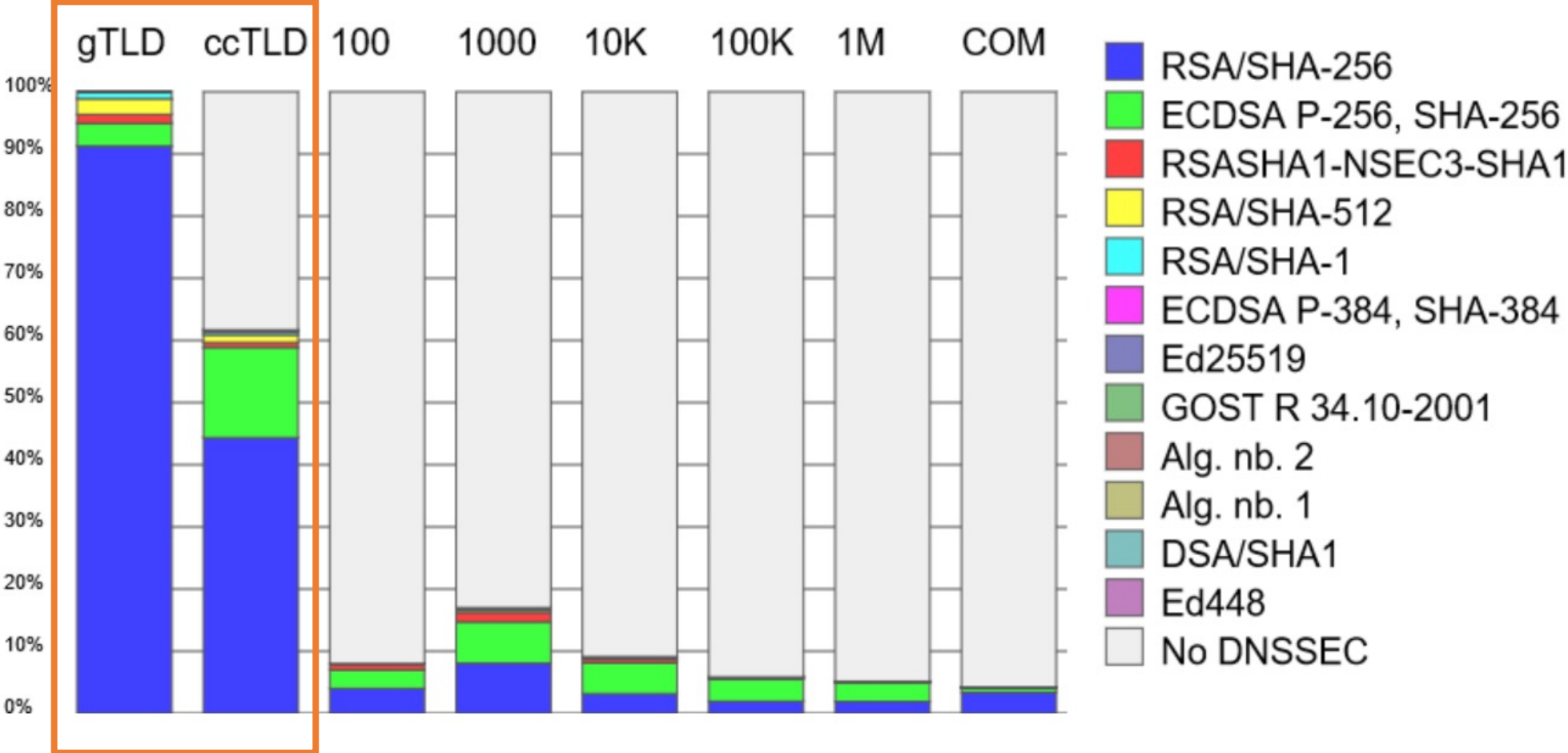
For reference, DNSSEC deployment at TLD level

Slicing and Dicing: DNSSEC deployment by category

- Do deployment rate vary per DNS Provider? Yes.
  - Provider with highest deployment: > 25%
  - Provider with lowest deployment : < 1%

- Do deployment rate vary per TLD? Yes.
  - TLD with highest deployment: > 50 %
  - TLD with lowest deployment : about 0.5 %

- Do deployment rate vary per site category? Yes
  - top 10K: 9.8%
  - top 100K: 6.2%
  - top 1M: 5.3%

Statistics per DNS Provider

- For all names in top 1 Million, find the Name Servers (NS records),
- Deduce DNS provider form DNS name of name server
- Compile statistics per provider and category:
  - top 10K, top 100K, top 1M
- In the following slides, we present data for the 10 DNS providers serving most domains across all categories
  - The "Total" line present the average DNSSEC deployment rate in each category, across all DNS Providers

Top 10 DNS Providers:
%DNSSEC in top 10K domains, August 2023
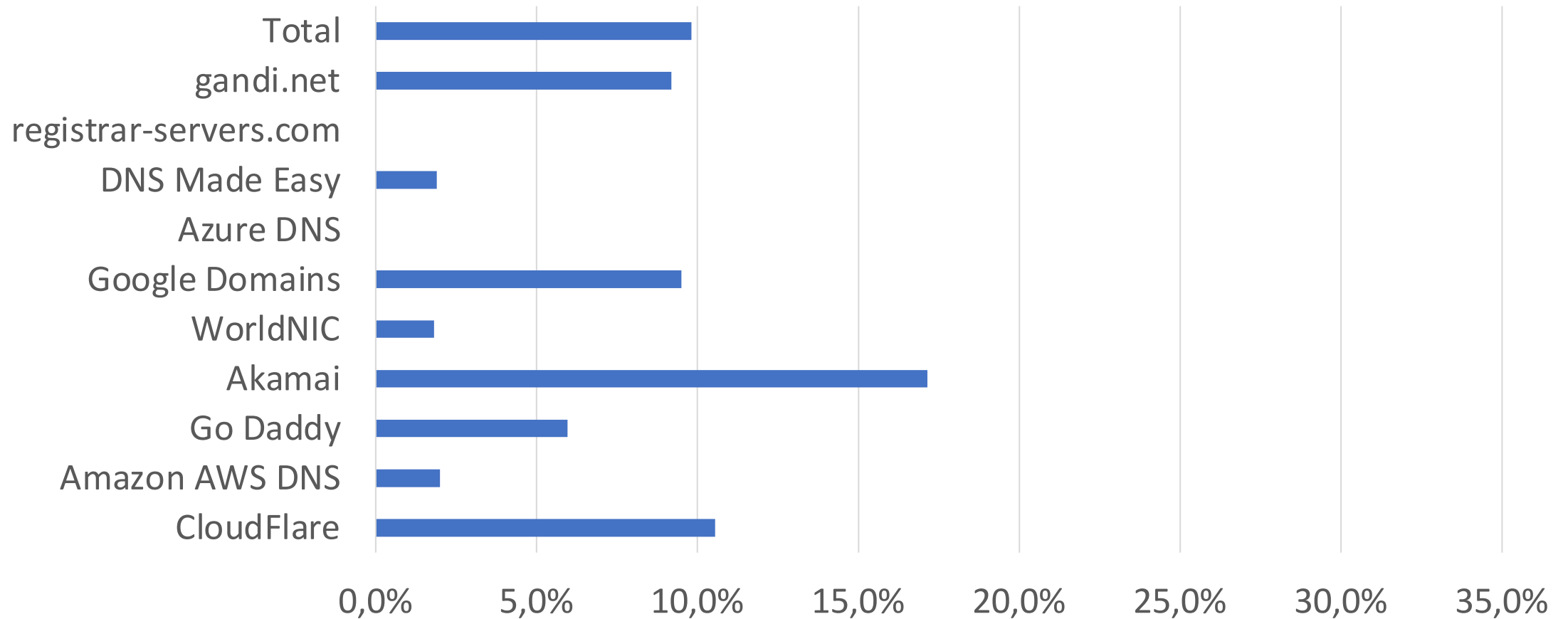
Top 10 DNS Providers: %DNSSEC in top 100K domains, August 2023
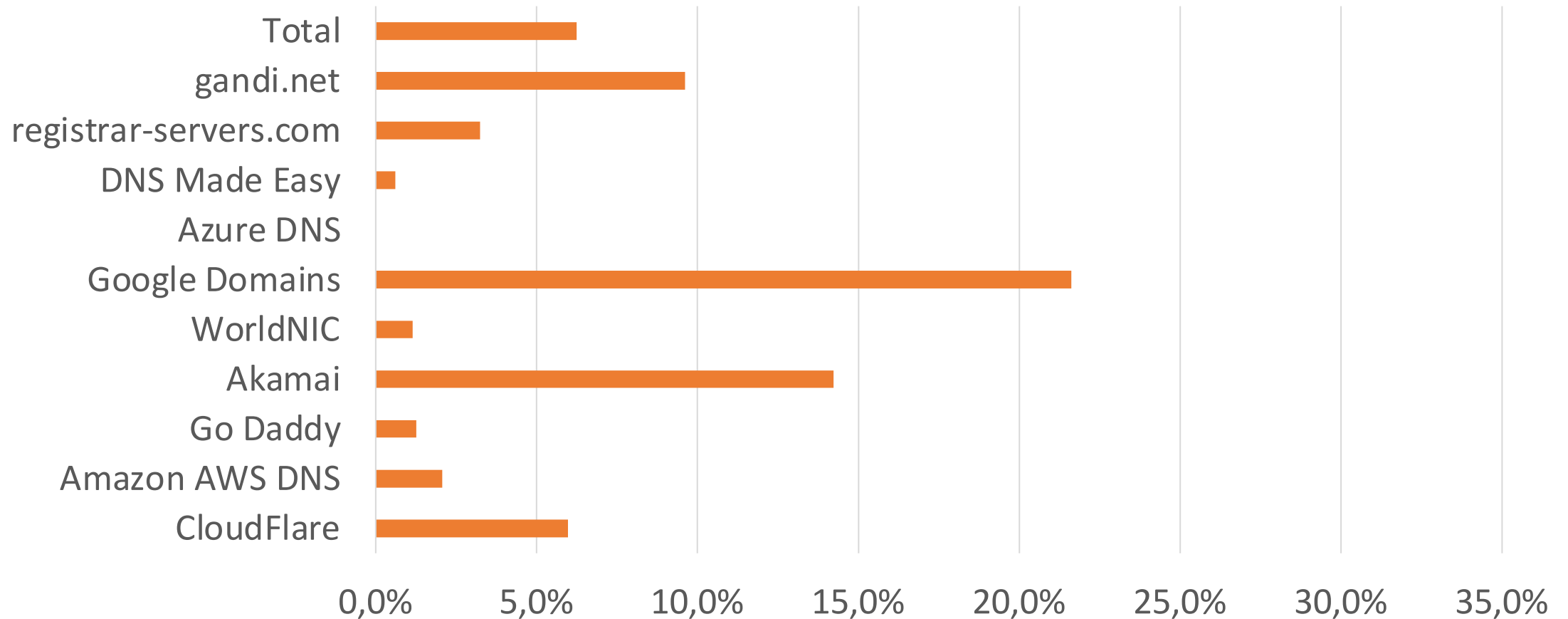
Top 10 DNS Providers: %DNSSEC in top 1M domains, August 2023
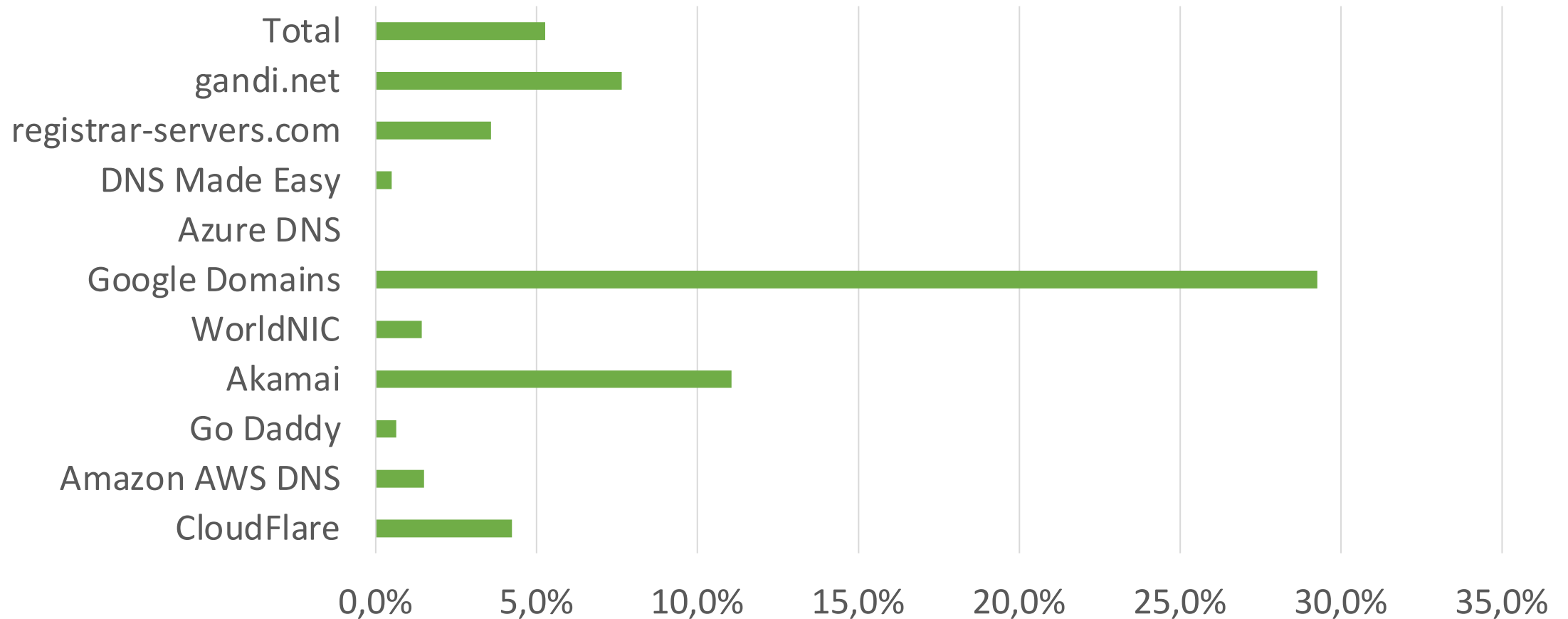
Yes, There is Variability of DNSSEC Deployment per DNS Provider

- Two providers have large DNSSEC deployment
    - Google Domains: nearly 30% in top 1M
    - Akamai: significantly above average, 11.1% in top 1M (versus average 5.3%)
- Two providers have DNSSEC close to average: Cloudflare, Gandi
- Azure DNS has 0% DNSSEC deployments
- 5 other providers have deployment rates below average

Statistics per TLD

- For all names in top 1 Million, find the Name Servers (NS records),
- Deduce TLD provider from DNS name
- Compile statistics per TLD and category:
  - top 10K, top 100K, top 1M
- We only trust statistics acquired for TLD serving enough domains
  - >= 0.1% share in each slice
  - 43 such TLD
- In the following slides, we present data for the 25 TLD accounting for most domains across all categories
  - The "Total" line present the average DNSSEC deployment rate in each category, across all TLDs

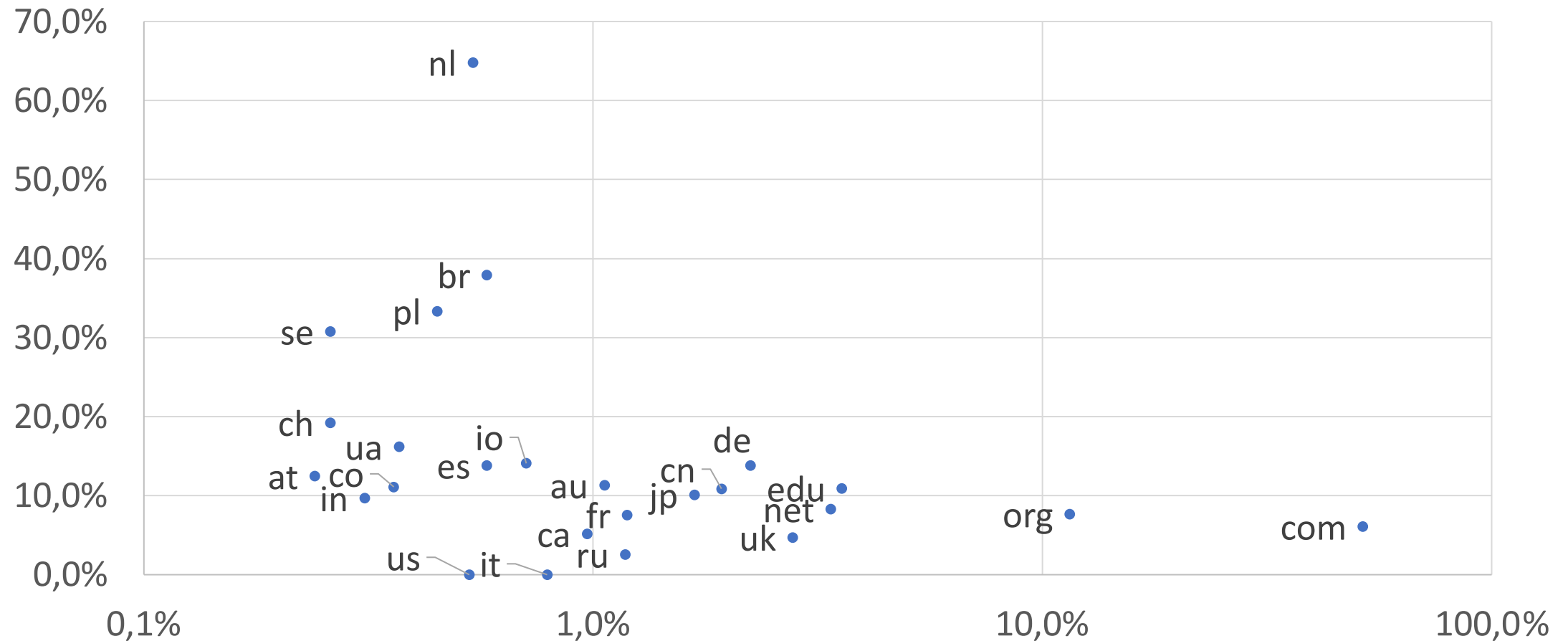# Top 25 TLD present in list of top 10K domains: %DNSSEC versus %domains

Top 25 TLD present in list of top 100K domains: %DNSSEC versus %domains
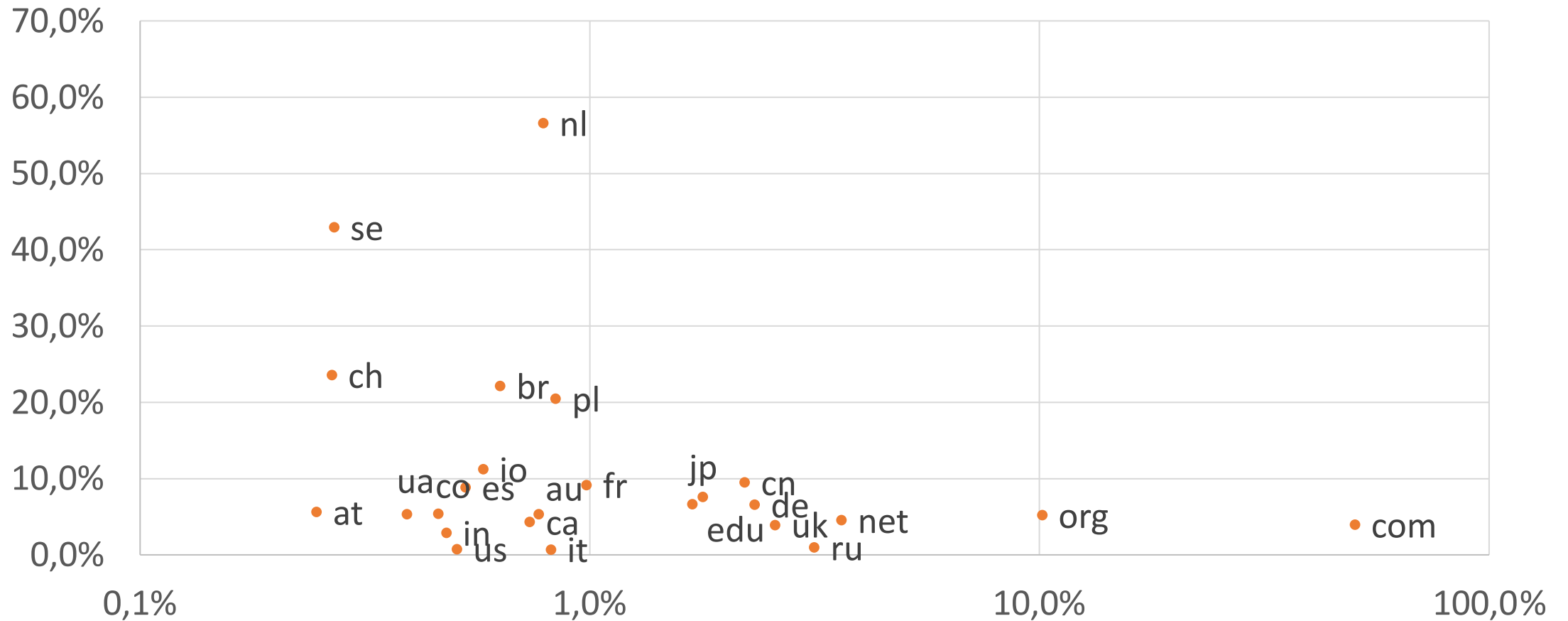
Top 25 TLD present in list of top 1M domains: %DNSSEC versus %domains
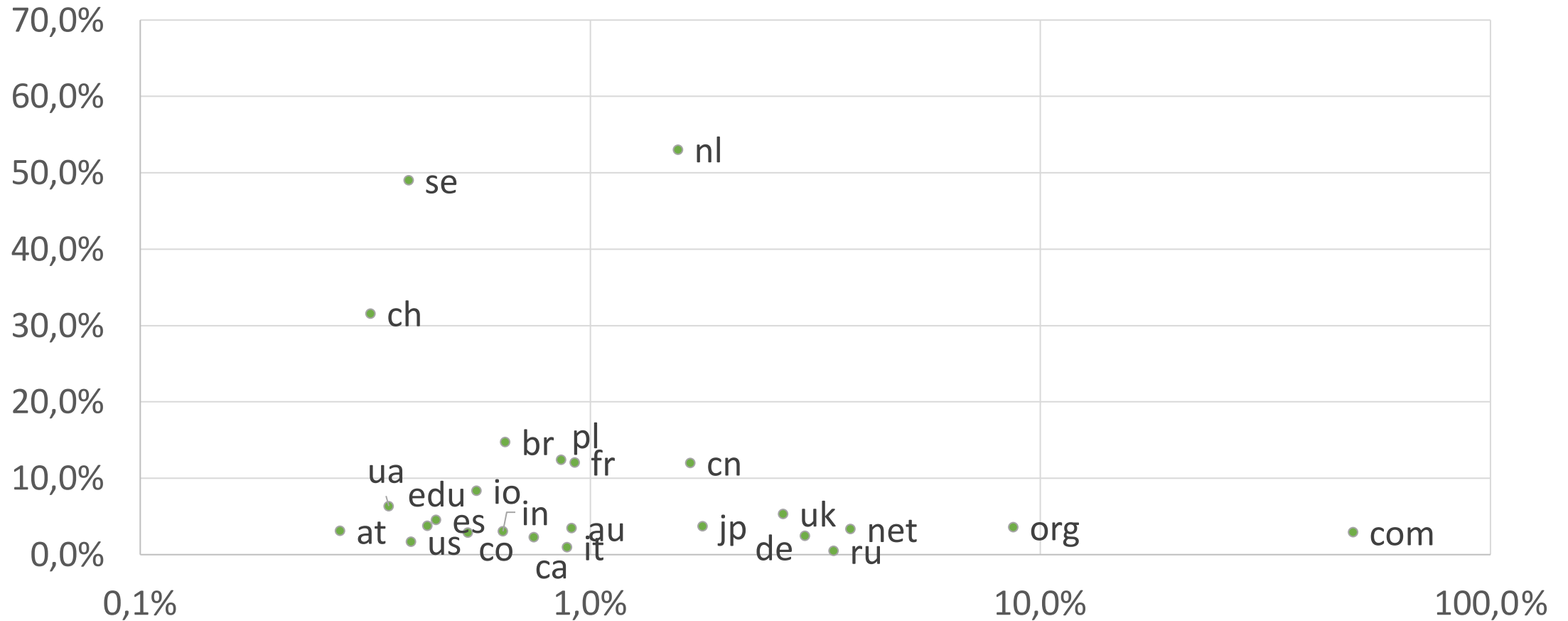
Yes, There is Variability of DNSSEC Deployment per TLD

- Some TLD see large DNSSEC deployment
  - NL, SE, CH, BR, PL, in top 25
    - In top 43, .DK, .CZ, and .NO have over 50% deployment
  - Known coordinated campaigns in .NL, .CZ, .DK
  - Probably similar campaigns in other TLD as well
- Big TLDs have average deployments
- Several TLD have deployments < 2%: .RU (0.5%), .IE, .IT, .TV, .US

Limits of slicing and dicing

- If a category is too small, the statistics are not reliable
  - Example:
    - suppose deployment rate of 10%, and just 10 samples.
    - there will be 35% chances of finding 0 deployment, and 26% chances of finding more than 1
  - Monthly comparisons would be very misleading
- The TLD graphs for top 10K, top 100K and top 1M look very similar
  - Much more variability in top 10K, where sample sizes per TLD are small
  - Not a lot of difference between top 100K and top 1M results
- The DNS Provider graphs show similar behavior
- Going forward, focus on top 1M
  - Sample sizes are larger, statistics are more significant
  - Trends and variability per TLD or per provider are similar

Conclusion

- Will continue these measurements every month

- Plan to perform additional analysis:
  - Look at DNS server hosting per CDN or Cloud Server
  - Track share of domains with "self hosted" NS servers
  - Look at web server hosting per CDN or Cloud server

- Questions?

Backup slides

Concentration of Authoritative DNS Services, August 2023
From: https://ithi.research.icann.org/graph-m9.html

Share, as of Aug 2023	top 100	101 to 1000	1001 to 10,000	10001 to 100,000	100,001 to 1M	COM zone
CloudFlare	5.3%	10.2%	17.9%	24.0%	21.3%	4.9%
GoDaddy	< 0.1%	0.3%	1.3%	4.1%	7.3%	23.4%
Amazon AWS DNS	14.4%	17.1%	15.7%	10.1%	5.4%	1.2%
google.com	12.1%	3.4%	2.1%	< 0.1%	< 0.1%	< 0.1%
Akamai	3.8%	7.9%	4.9%	1.5%	0.4%	< 0.1%
NS1	6.8%	5.0%	2.8%	1.0%	0.5%	1.3%

Share of algorithms used in DNSSEC,
From: https://ithi.research.icann.org/graph-m11.html

Share, as of Aug 2023	gTLD	ccTLD	top 100	101 to 1000	1001 to 10,000	10001 to 100,000	100,001 to 1M	COM zone
DNSSEC Total	100.0%	61.7%	8.0%	17.0%	9.1%	5.8%	5.2%	4.2%
RSA/SHA-256	91.3%	44.4%	4.0%	8.1%	3.2%	1.9%	1.9%	3.4%
ECDSA P-256, SHA-256	3.7%	14.5%	3.0%	6.7%	4.9%	3.5%	3.1%	0.8%
RSASHA1-NSEC3-SHA1	1.4%	0.8%	1.0%	1.5%	0.5%	0.1%	< 0.1%	< 0.1%
RSA/SHA-512	2.5%	1.2%	< 0.1%	0.3%	0.1%	0.1%	< 0.1%	< 0.1%
RSA/SHA-1	1.1%	0.4%	< 0.1%	0.2%	0.2%	< 0.1%	< 0.1%	< 0.1%
ECDSA P-384, SHA-384	< 0.1%	0.4%	< 0.1%	0.1%	< 0.1%	< 0.1%	< 0.1%	< 0.1%
Ed25519	< 0.1%	< 0.1%	< 0.1%	0.1%	< 0.1%	< 0.1%	< 0.1%	< 0.1%
GOST R 34.10-2001	< 0.1%	< 0.1%	< 0.1%	< 0.1%	< 0.1%	< 0.1%	< 0.1%	< 0.1%
Alg. nb. 2	< 0.1%	< 0.1%	< 0.1%	< 0.1%	< 0.1%	< 0.1%	< 0.1%	< 0.1%
Alg. nb. 1	< 0.1%	< 0.1%	< 0.1%	< 0.1%	< 0.1%	< 0.1%	< 0.1%	< 0.1%
DSA/SHA1	< 0.1%	< 0.1%	< 0.1%	< 0.1%	< 0.1%	< 0.1%	< 0.1%	< 0.1%
Ed448	< 0.1%	< 0.1%	< 0.1%	< 0.1%	< 0.1%	< 0.1%	< 0.1%	< 0.1%

DNSSEC deployment in top providers, August 2023

provider	share-10k	dnssec-10k	share-100k	dnssec-100k	share-1M	dnssec-1M
cloudflare.com	20.5%	10.6%	26.1%	6.0%	22.7%	4.2%
awsdns-??.com	19.0%	2.0%	12.0%	2.1%	6.3%	1.5%
domaincontrol.com	1.5%	6.0%	4.2%	1.3%	7.3%	0.6%
akam.net	5.8%	17.1%	1.9%	14.2%	0.6%	11.1%
worldnic.com	0.5%	1.8%	1.3%	1.1%	2.6%	1.4%
googledomains.com	1.6%	9.5%	1.2%	21.6%	1.1%	29.3%
azure-dns.com	1.5%	0.0%	1.3%	0.0%	0.8%	0.0%
dnsmadeeasy.com	1.3%	1.9%	1.1%	0.6%	0.7%	0.5%
registrar-servers.com	0.3%	0.0%	0.6%	3.2%	1.1%	3.6%
gandi.net	0.5%	9.2%	0.6%	9.6%	0.6%	7.6%
others	47.4%	12.5%	49.7%	7.6%	56.2%	6.5%
total	100.0%	9.8%	100.0%	6.2%	100.0%	5.3%

DNSSEC deployment in top TLD, August 2023

tld	share-10k	dnssec-10k	share-100k	dnssec-100k	share-1M	dnssec-1M
com	51.7%	6.1%	50.3%	4.0%	49.5%	2.9%
org	11.5%	7.7%	10.1%	5.2%	8.7%	3.6%
net	3.4%	8.3%	3.6%	4.6%	3.8%	3.4%
uk	2.8%	4.7%	2.6%	4.0%	2.7%	5.3%
de	2.2%	13.8%	2.3%	6.6%	3.0%	2.5%
jp	1.7%	10.1%	1.8%	7.6%	1.8%	3.7%
cn	1.9%	10.9%	2.2%	9.5%	1.7%	12.0%
ru	1.2%	2.5%	3.2%	1.0%	3.5%	0.5%
fr	1.2%	7.6%	1.0%	9.1%	0.9%	12.1%
it	0.8%	0.0%	0.8%	0.7%	0.9%	1.0%
au	1.1%	11.3%	0.8%	5.3%	0.9%	3.5%
ca	1.0%	5.2%	0.7%	4.4%	0.7%	2.3%
br	0.6%	37.9%	0.6%	22.2%	0.6%	14.7%
io	0.7%	14.1%	0.6%	11.2%	0.6%	8.4%
nl	0.5%	64.8%	0.8%	56.6%	1.6%	53.0%
pl	0.5%	33.3%	0.8%	20.5%	0.9%	12.4%
es	0.6%	13.8%	0.5%	8.9%	0.5%	4.5%
us	0.5%	0.0%	0.5%	0.8%	0.4%	1.7%
co	0.4%	11.1%	0.5%	5.4%	0.5%	2.9%
ua	0.4%	16.2%	0.4%	5.4%	0.4%	6.4%
in	0.3%	9.7%	0.5%	2.9%	0.6%	3.1%
edu	3.6%	10.9%	1.7%	6.7%	0.4%	3.8%
se	0.3%	30.8%	0.3%	43.0%	0.4%	49.0%
ch	0.3%	19.2%	0.3%	23.6%	0.3%	31.6%

tld	share-10k	dnssec-10k	share-100k	dnssec-100k	share-1M	dnssec-1M
at	0.2%	12.5%	0.2%	5.7%	0.3%	3.1%
gov	2.5%	70.3%	0.8%	52.1%	0.3%	27.6%
be	0.3%	17.9%	0.2%	19.1%	0.3%	18.1%
me	0.4%	5.6%	0.2%	5.8%	0.2%	4.4%
cz	0.2%	52.6%	0.4%	58.9%	0.4%	53.5%
id	0.2%	36.8%	0.2%	9.9%	0.2%	4.5%
kr	0.2%	23.5%	0.5%	4.1%	0.5%	5.1%
eu	0.2%	17.6%	0.4%	11.8%	0.4%	14.4%
info	0.2%	12.5%	0.5%	5.8%	0.7%	2.9%
tv	0.2%	12.5%	0.2%	1.6%	0.2%	1.6%
tw	0.2%	20.0%	0.3%	12.7%	0.2%	9.2%
ie	0.2%	6.7%	0.1%	1.4%	0.2%	0.7%
no	0.1%	28.6%	0.2%	42.2%	0.2%	34.0%
fi	0.1%	0.0%	0.2%	5.3%	0.2%	6.2%
mx	0.1%	16.7%	0.1%	3.9%	0.1%	4.6%
nz	0.2%	10.5%	0.1%	10.5%	0.2%	4.4%
za	0.1%	9.1%	0.1%	3.5%	0.2%	3.7%
pt	0.1%	27.3%	0.1%	21.9%	0.1%	11.5%
dk	0.1%	50.0%	0.1%	59.5%	0.3%	71.3%
others	5.5%	9.3%	8.0%	5.7%	9.7%	3.9%
Total	100.0%	9.8%	100.0%	6.2%	100.0%	5.3%