Measurement of CDS/CDNSKEY inconsistencies

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How inconsistent are CDS/CDNSKEY across auths?

- **Asking a single nameserver does not ensure consistency**
  - This **can go seriously wrong**
  - Example failure modes: **multi-homing, provider change, lame delegation hijack**
  - In multi-provider setups: **each party is a single point of failure**

  → draft-ietf-dnsop-cds-consistency proposes consistency check before acting

- **How about measuring prevalence of this?**
- Max Planck researchers F. Steurer and T. Fiebig **collected CDS/CDNSKEY**
  - **~300M** eTLD+1 domains
- Asked each authoritative NS for both RRsets
  - Both parent and child side NS

Basic Insights

- How to classify unreachable NS?
  - draft-ietf-dnsop-cds-consistency **assumes consistency** (after retries)
    → treat similarly for this study

Number of zones (1–5% have timeouts for some NS):

- 8.4M with CDS
- 1.3M with CDNSKEY

Instances of **inconsistent RRset content across NS** (including empty, ignoring TTL):

- 6886 for CDS = 0.08%
- 853 for CDNSKEY = 0.07%

→ Around 1/1000 of zones have inconsistent CDS/CDNSKEY records

Case Study: $redacted.ch

```
$ dig +noall +auth @a.nic.ch. $redacted.ch. NS
$redacted.ch.   3600IN  NS  ns1.$redactedNS1.   ; and ns2
$redacted.ch.   3600IN  NS  ns1.$redactedNS2.   ; and ns2

$ dig +short @ns1.$redactedNS1. $redacted.ch. CDS
3714 13 2 6EF464A4FBA7A432CCCF84FE1253BE4144DF438D99AC1D3292434507…
3714 13 4 E3F6D5992515F46BAB55CC362F3137F35F9ED00F18A582DC5CEDD62A…
$ dig +short @ns1.$redactedNS1. $redacted.ch. CDNSKEY
257 3 13 /JFSTlxQo8av9zzv4qmbhj3lQwfXR9zGZ2HVBCjIk+7Z+2rh2cyW1L2A…

$ dig +short @ns1.$redactedNS2. $redacted.ch. CDS
19170 13 2 0467ACE2E19997D180EC0B4CC0747E637FB6CD32F8D36B65EDBEBC2A…
19170 13 4 ED4F2E45477F18FCBDCE9486FBEDB8784078C5B918BC27535E485737…
$ dig +short @ns1.$redactedNS2. $redacted.ch. CDNSKEY
257 3 13 KiTFHfBpLEkRwkNrC6IJKAP5Zoo8vB8Ubm0vCOa77ZN7V+h/Z6mf8fRl…
```

Case Study: $redacted.ch

- .ch performs CDS processing (https://www.nic.ch/security/cds/)

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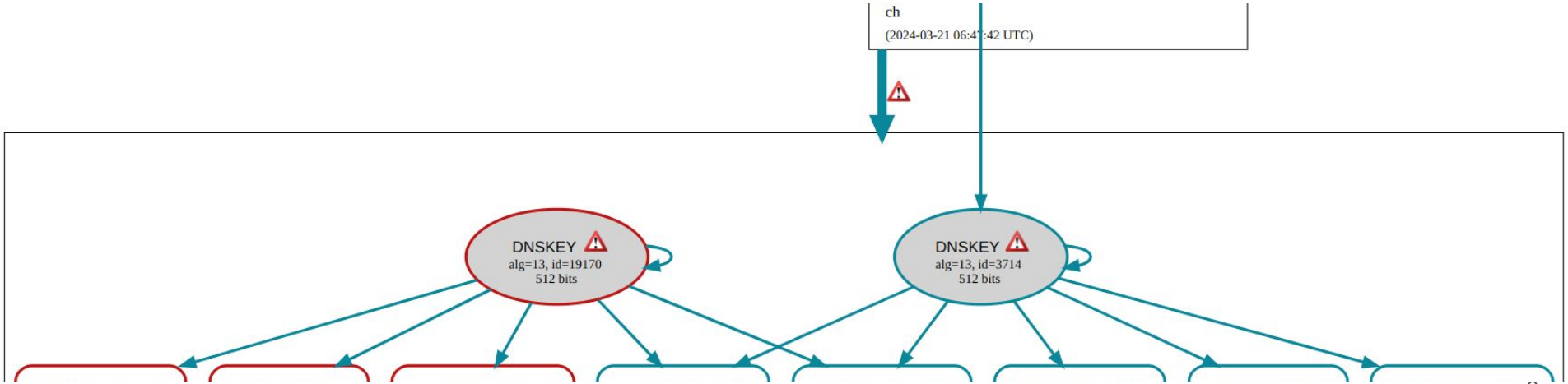
```
$ dig +short $redacted.ch. DS
3714 13 2 6EF464A4FBA7A432CCCF84FE1253BE4144DF438D99AC1D3292434507…
3714 13 4 E3F6D5992515F46BAB55CC362F3137F35F9ED00F18A582DC5CEDD62A…
```



Case Study: $redacted.com

```
$ dig +noall +auth @d.gtld-servers.net. $redacted.com NS
$redacted.com.  172800  IN  NS  ns-cloud-b2.googledomains.com.
$redacted.com.  172800  IN  NS  ns-cloud-b3.googledomains.com.
$redacted.com.  172800  IN  NS  ns-cloud-b4.googledomains.com.
$redacted.com.  172800  IN  NS  ns-cloud-a1.googledomains.com.

$ dig +short @ns-cloud-b2.googledomains.com. $redacted.com CDS
44854 8 2 D8747EE52247BFF70061DCC4941214316935426D186D478A24A2EBBB…
$ dig +short @ns-cloud-b3.googledomains.com. $redacted.com CDS
44854 8 2 D8747EE52247BFF70061DCC4941214316935426D186D478A24A2EBBB…
$ dig +short @ns-cloud-b4.googledomains.com. $redacted.com CDS
44854 8 2 D8747EE52247BFF70061DCC4941214316935426D186D478A24A2EBBB…
$ dig +short @ns-cloud-a1.googledomains.com. $redacted.com CDS
32551 8 2 7F72E32B74402ABB68954FCF5A98E329A0D0D559B864ED1399E92CA8…
```

More Insights

- 90-95% of cross-NS inconsistencies are because one NS serves empty
- 402 instances of all-nonempty inconsistent CDS remaining
- 248 of those are with Google Domains & WixDNS
  - All kinds of anomalies observed (e.g., WixDNS in parent, Google Domains in child)
  - Similar observations with other provider combinations
- Usually not true multi-signer setups (no KSK exchange)
- Usually not even securely delegated

Conclusion

- Weird misconfigurations happen at both small and large DNS operators!
- Significant number of domains breaks without proper DS acceptance checks
  - This includes CDS/CDNSKEY consistency checks
- Automated DS provisioning should not tolerate 0.1% failure rate