New (and Old) Kid on the block: GeoDNS Authoritative Server

(abstract)

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Introduction

- `GeoDNS` is the authoritative DNS server for `NTPPool`
  - supports geo routing and load balancing
  - Not a full-fledged authoritative server
  - used in production since 2013
- How come we found it?
  - We started a public NTP service (2019):
    - `https://time.nl`
  - We connect it to the `NTPPool`:
    - `https://www.ntppool.org/a/TimeNL`

Figure 1: GPS/Galileo and DCF77 antennas on SIDN's roof

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The NTPPool project

- Volunteer-based
- **Maps users to servers**, using DNS
- Makes it easier to share NTP servers
  - >5k servers (2021)
- Massively used by Linux (incl. Android), vendors (Sonos, Asus, etc.)

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GeoDNS: an user perspective

- I cannot speak for the developers
  - (I'm just an user)
- Information here present based on experience, rev. engineering it
- GeoDNS documentation is *incomplete*

GeoDNS: how many people have heard about it?

- It's open-source
  - https://github.com/abh/geodns
- Written in Go

GeoDNS: features (not complete)

It supports

- TPC/UDP
- IPv4/IPv6
- A, AAAA, NS, MX, SOA, CNAME, SPF, TXT, CNAME
- EDNS client subnet (ECS)
- DNS cookies
- NSDI

It does not support

- DNSSEC
- TTL values *per record*
  - only global TTLs
  - altought there is a fix: https://github.com/abh/geodns/issues/118
- Rate-limiting

Traditional zone files

```
nl.      172800  IN  NS  ns1.dns.nl.
nl.      172800  IN  NS  ns2.dns.nl.
nl.      172800  IN  NS  ns3.dns.nl.
nl.      86400 IN  DS  34112 8 2 3
    C5B5F9B3557455C50751A9BE9EBE9238C88E19F5F07F930976917B51B95CD22
nl.      86400 IN  RRSIG DS 8 1 86400 20211128050000 20211115040000 14748 .
    bMDGjWGUGcYheyYVWICqwzxWriep3nSH+sNCKOGspDjIrSwK2nuf/CNUqcX17cS5/8
    gxhROYssTWXyq0F/o0Obbjbx3kUNSR+S9xXNS93i1jNc+23
    gRKcNJ7PBJKe31ttGzSOG2IeFcKg2pjY0VEZWer9sx7r8CR2Z6sLcF2tcjxbbA/Qy3Q2L/
    WIKmk+TQoE09tmYv/oPtw0C6LHMw35FCCXOXM+MpcKGhr9nJl6ss82wvh8frmAuR5ombjZ+
    jFZxpMQzAtErY2OszElPSRon/xc72xtq5jiifDS/
    ndSs5XnvWXoBjgY4550ZpjfxvGH2rGGl13kpbCNOPrh1Xsmw==
nl.      86400 IN  NSEC  no. NS DS RRSIG NSEC
```

Listing 1: Part of the Root DNS zone file.

GeoDNS zone files

```
1  {  "us" : { #sub-zone: us.pool.ntp.org
2           "a" : [
3              ["192.168.1.1","100"],
4              ["192.168.2.1","1" ],
5
6     "tr" : { #sub-zone: tr.pool.ntp.org
7           "a" : [
8              ["77.243.184.65", "100"],
9              ["212.175.18.126","1" ],
10      ...}
```

Listing 2: GeoDNS demo zone file for `pool.ntp.org`.

- to parse a zone file: `json.load(zone)`

GeoDNS zone files

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```

Listing 3: GeoDNS demo zone file for `pool.ntp.org`.

- to parse a zone file: `json.load(zone)`

GeoDNS zone files: supports geographical subzones

- Say you have a domain: `example.nl`
- You can define your subzones:
  - `us.example.nl`
  - `europe.example.nl`
- Goal (pool): maps users to servers nearby

94.198.159.10 / ntp1.time.nl
Account: marco.davids@sidn.nl (#1envh99)
Zones: @ europe nl

https://www.ntppool.org/scores/94.198.159.10

NTPPool: how it works

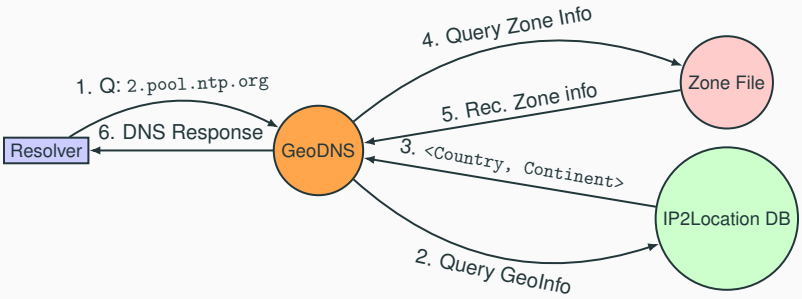

Figure 2: DNS client and GeoDNS relationship.

Alternatives and why use GeoDNS

- PowerDNS and BIND have similar features
  - But GeoDNS was developed first
  - And PowerDNS and BIND are more complex
- Why use GeoDNS:
  - **Simplicity**
  - zone files in JSON
    - a Python dict
    - automatic reload, easy to add/remove servers
- (We evaluate how GeoDNS and the NTPPool in [1][1])

[1] https://www.sidnlabs.nl/downloads/5aPx86UtFmvKs6WE3LHwbU/908f5eb78bbae18908fb8b4f47bbb991/Diving_into_the_NTP_Pool.pdf

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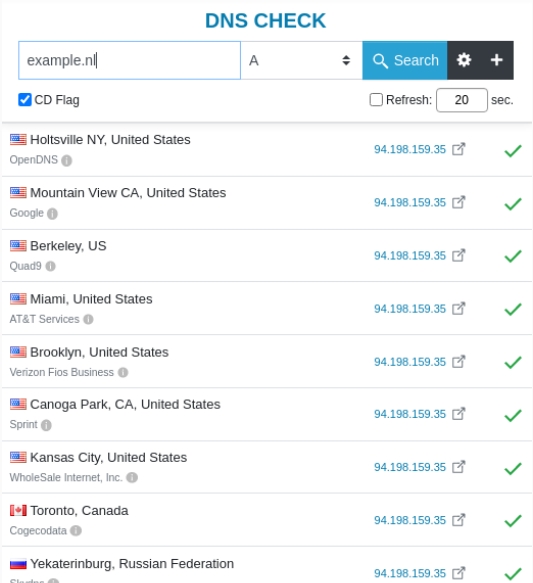
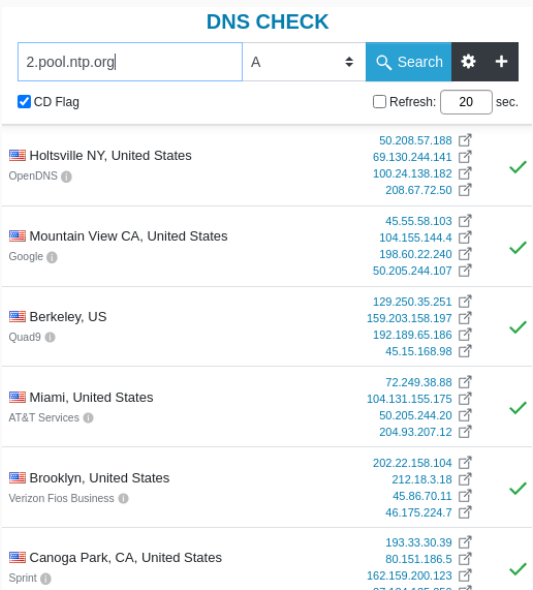
Research opportunities:

1. Performance evaluation
2. Any geolocation and load balancing routing study can use `GeoDNS`
3. Can we make it mainstream within the DNS community?

Demo: "regular" DNS



Demo: GeoDNS


DNS CHECK
2.pool.ntp.org
A
Search
CD Flag
Refresh:
20
sec.
Holtsville NY, United States
OpenDNS
50.208.57.188
69.130.244.141
100.24.138.182
208.67.72.50
Mountain View CA, United States
Google
45.55.58.103
104.155.144.4
198.60.22.240
50.205.244.107
Berkeley, US
Quad9
129.250.35.251
159.203.158.197
192.189.65.186
45.15.168.98
Miami, United States
AT&T Services
72.249.38.88
104.131.155.175
50.205.244.20
204.93.207.12
Brooklyn, United States
Verizon Fios Business
202.22.158.104
212.18.3.18
45.86.70.11
46.175.224.7
Canoga Park, CA, United States
Sprint
193.33.30.39
80.151.186.5
162.159.200.123

Summary

- `GeoDNS` is old (2013) and new (for most DNS folks)
- It's fast and simple
- Used in production
- And not a full-fledged authoritative DNS
- May do the job for you

References i

[1] Moura, G. C. M., Davids, M., Schutijser, C., and Hesselman, C.

Diving into the NTP Pool.

Tech. rep., SIDN Labs, Arnhem, The Netherlands, 2021.