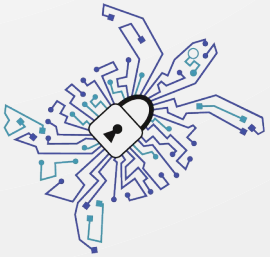
Experiences with DoH Server Software

DNSheads Vienna Meetup

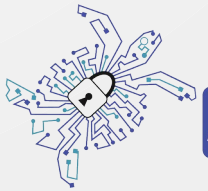
June 2019



Foundation for Applied Privacy

Foundation for Applied Privacy

- Non-profit Privacy Infrastructure Provider
- We run privacy services for the public
- founded in 2018
- ISPA member



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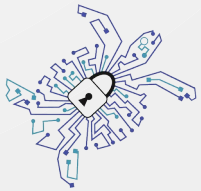
Agenda

- Why encrypt DNS traffic
- Our experiences with:
  - doh-httpproxy
  - knot-resolver
  - rust-doh
  - dnsdist
- Summary and Recommendations



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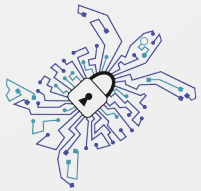
Motivation



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User/Browser

de.wikipedia.org
Webserver

DNS
Resolver

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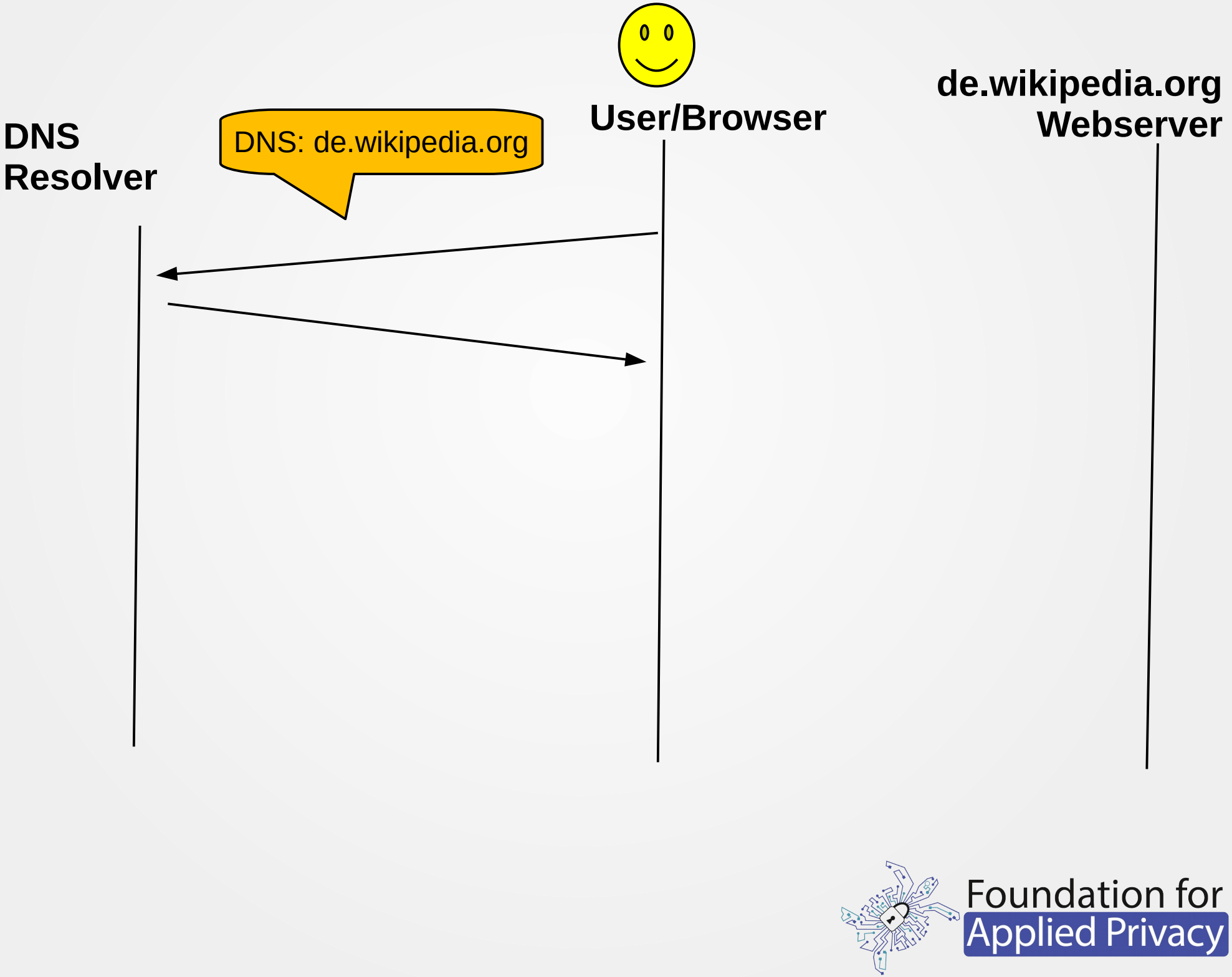

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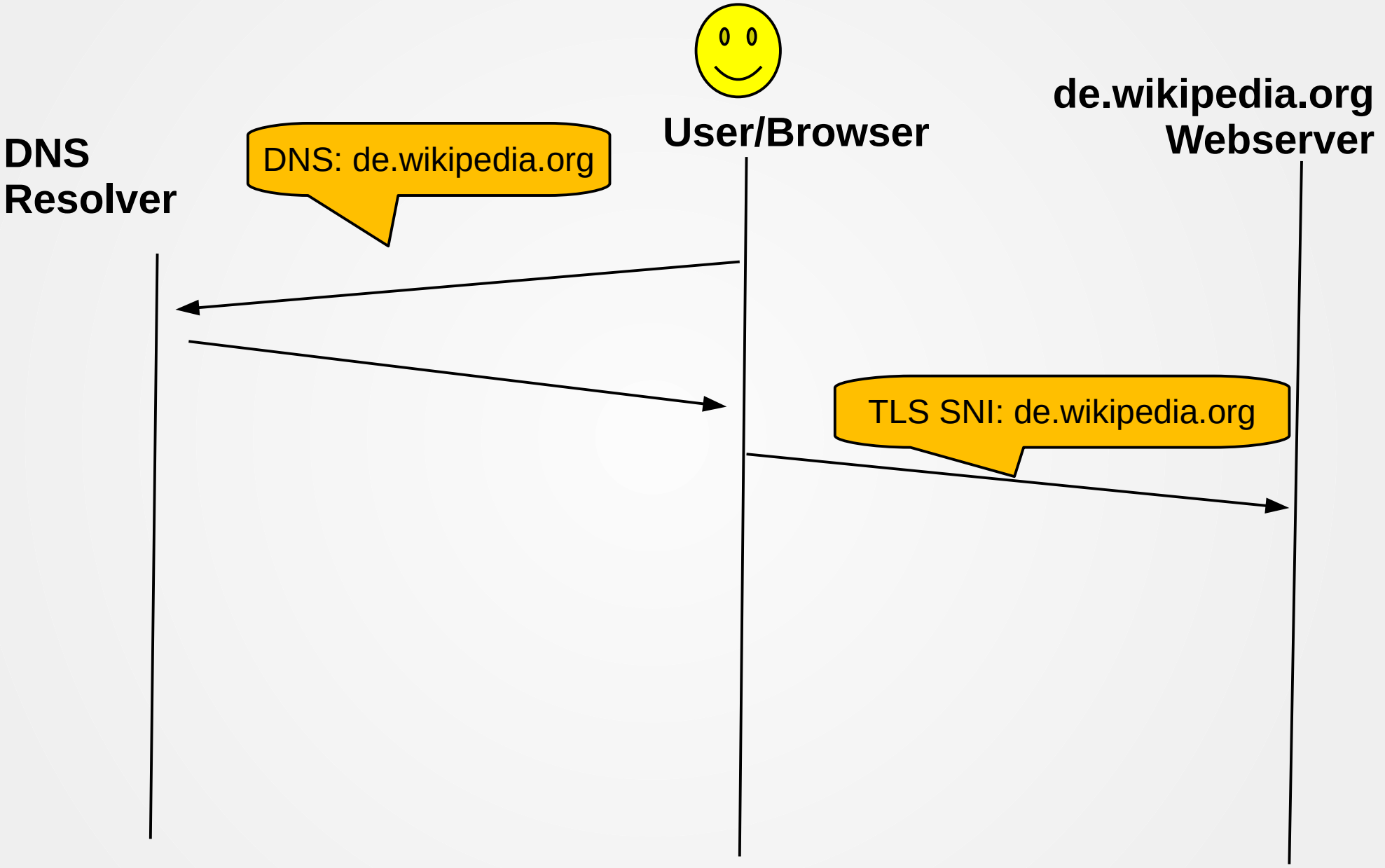

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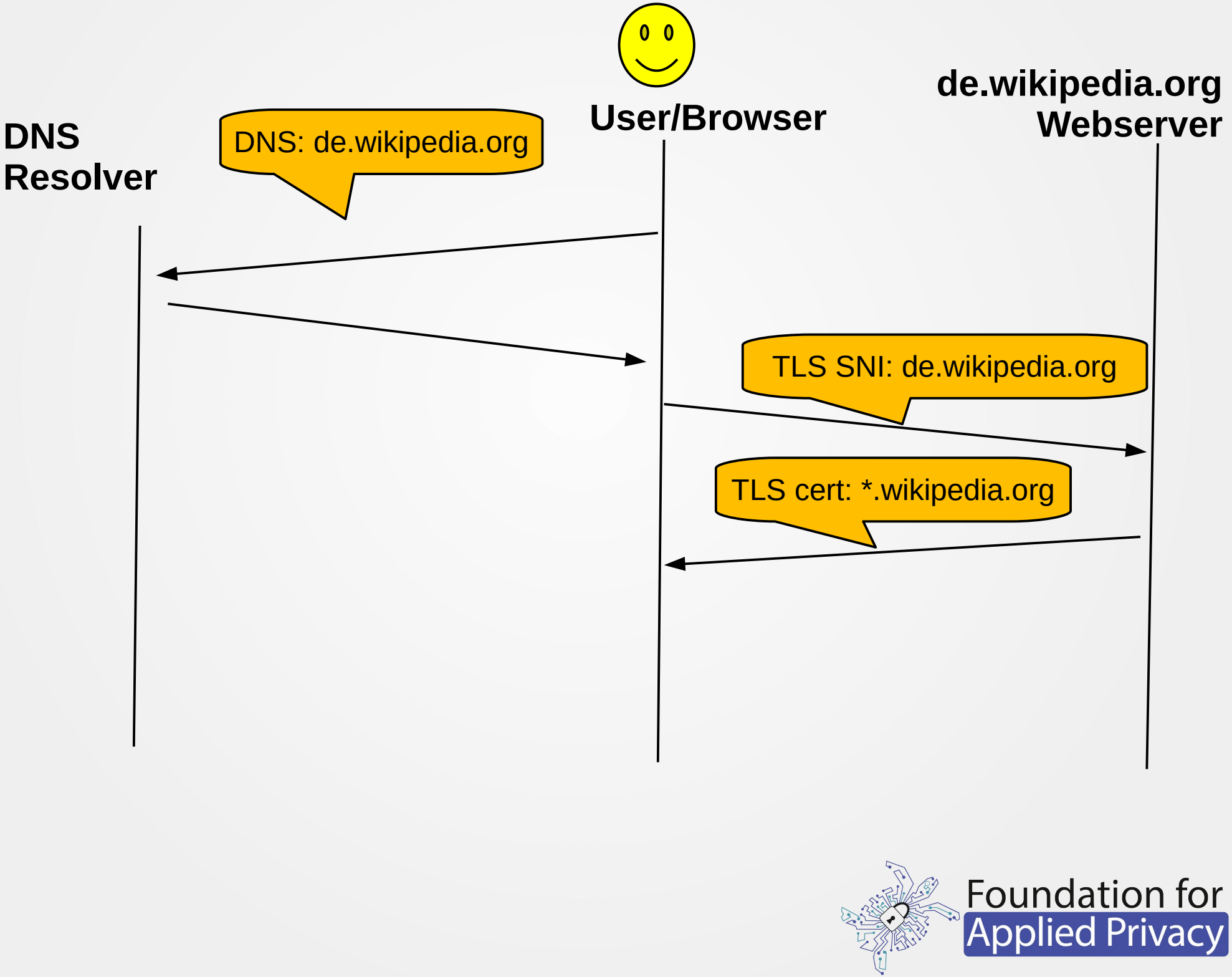

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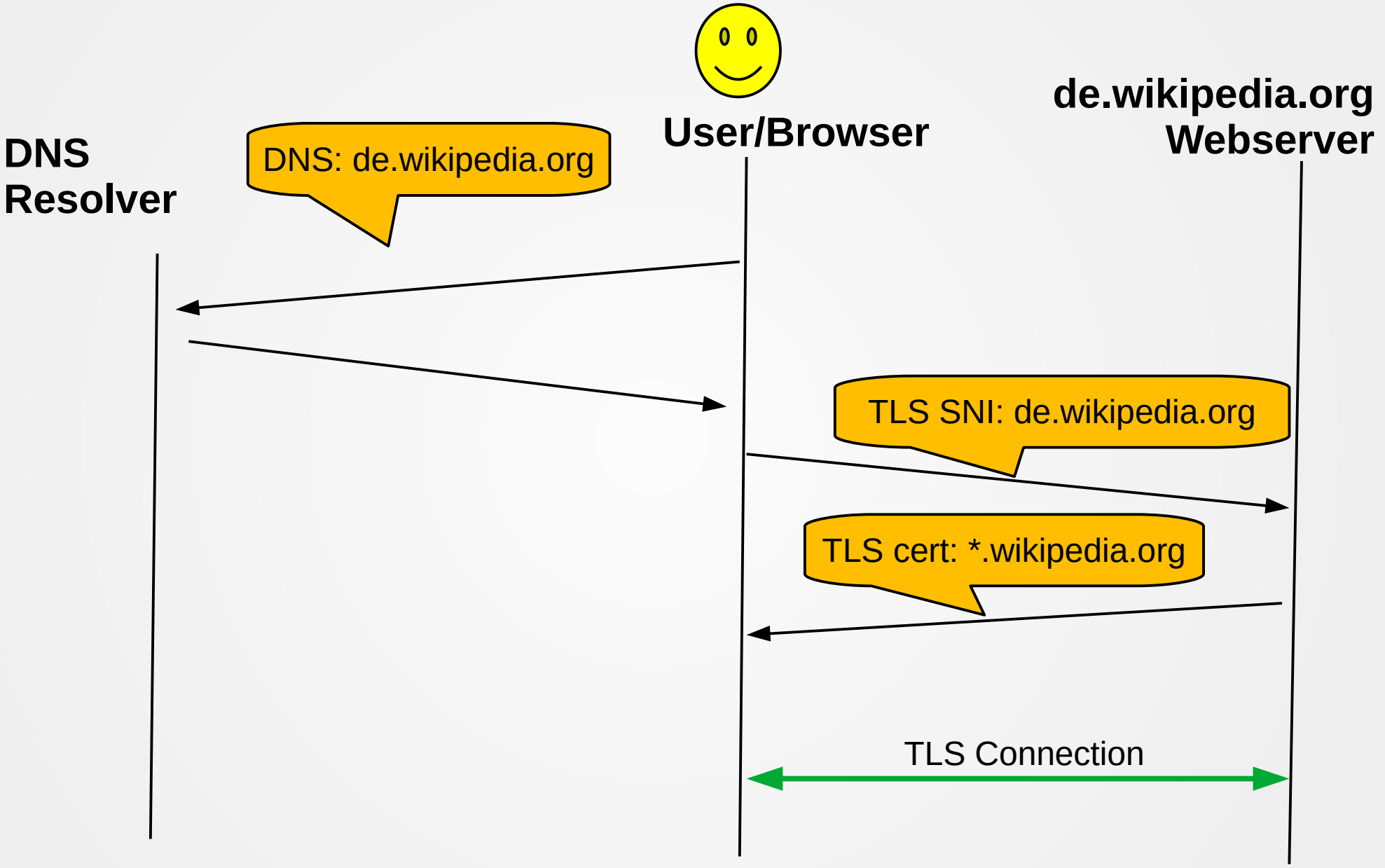

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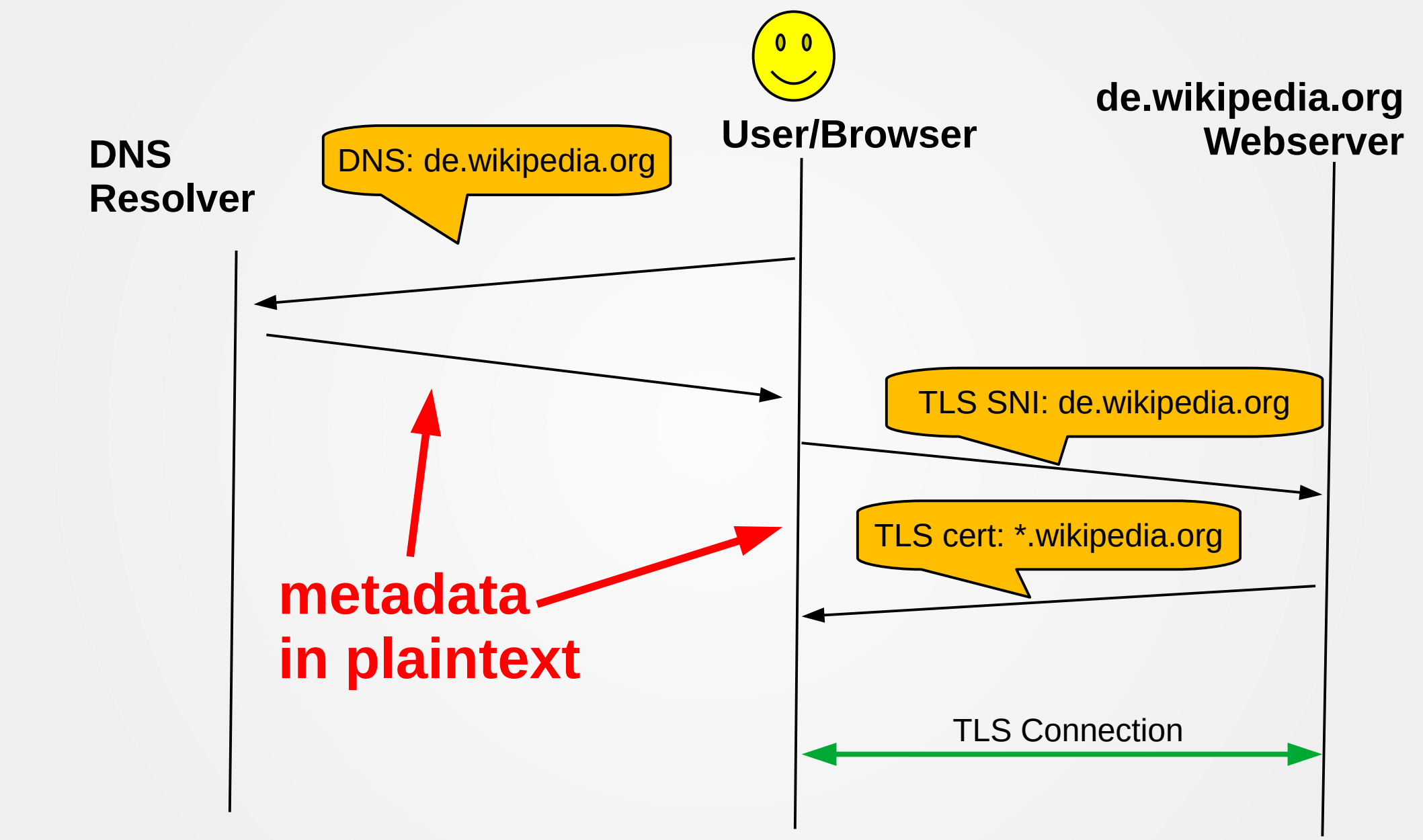

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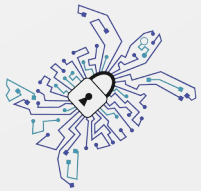
Leak	Solution	Effort for website operator
IP address	CDN/vHosts	~
TLS SNI	Work in Progress: Encrypted SNI (ESNI)	Big effort (Webserver + DNS)
TLS certificate	TLS 1.3	deploy TLS 1.3
OCSP	OCSP Stapling	Minor configuration effort
DNS	**DoH/DoT/...**	No effort (owner not involved)



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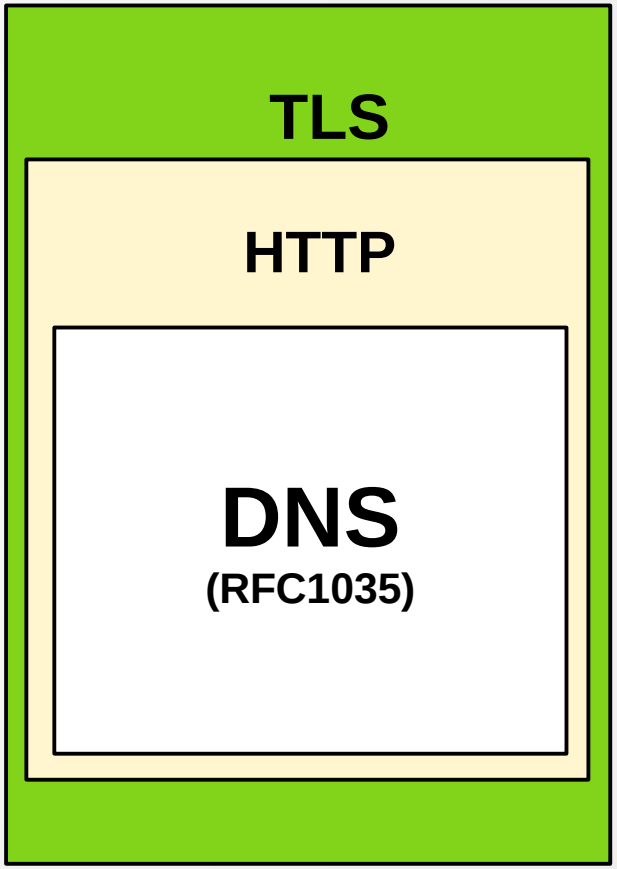
DoH (RFC8484)

- HTTPS (TCP/443)
- **POST**
- or GET (base64url)
- HTTP/2 (recommended)
- Content Type: application/dns-message



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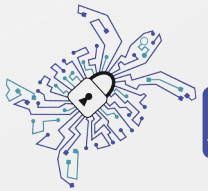
Encrypt all the things, DNS included!

Foundation for Applied Privacy — 2019-03-29 20:52

tldr; Today we are launching our new DNS Privacy Services supporting the DNS-over-TLS and DNS-over-HTTPS protocols.

https://appliedprivacy.net/posts/dns-privacy-services-launch/



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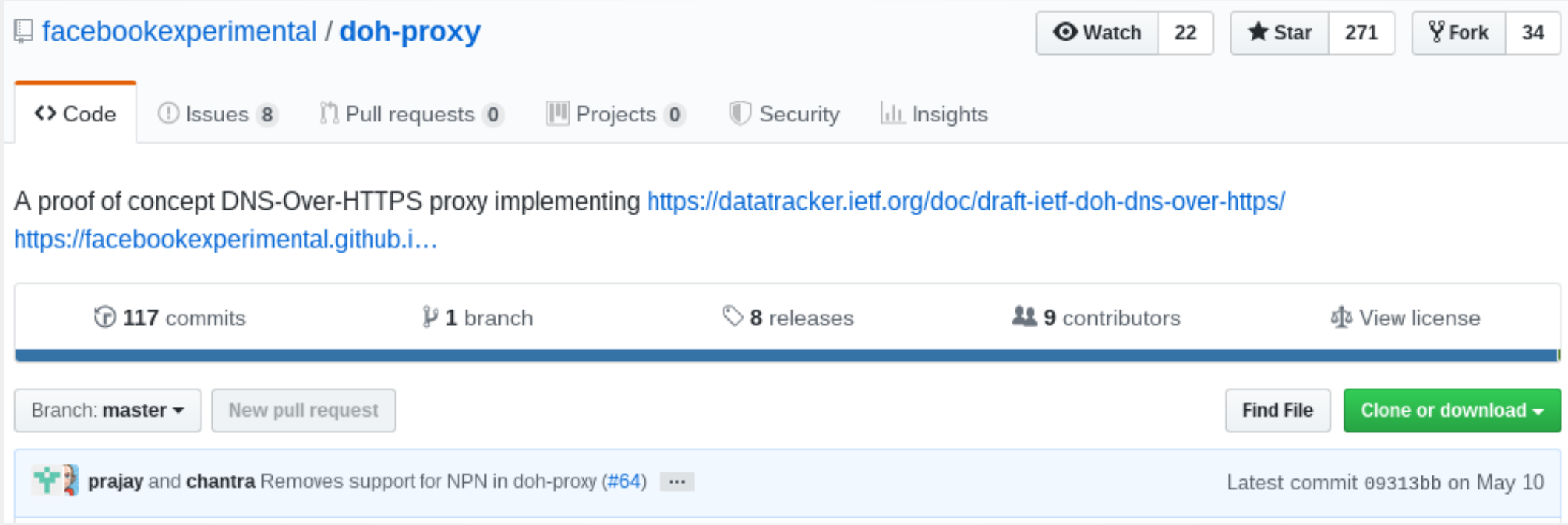
doh-(http)proxy



https://github.com/facebookexperimental/doh-proxy

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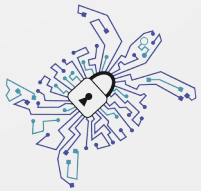
doh-httpproxy

nginx → doh-httpproxy → unbound



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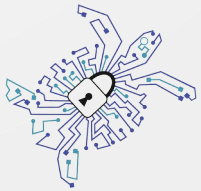
doh-httpproxy

- easy setup (+)
- IETF hackaton proof-of-concept (-)
- no metrics (-)
- single DNS backend only (-)



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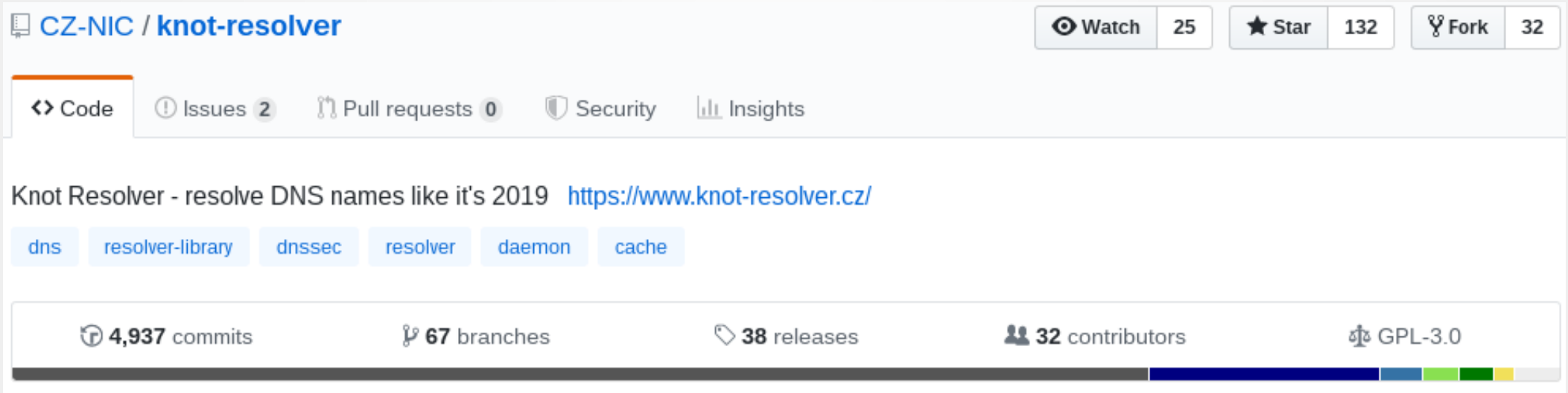
knot-resolver 4.0.0



https://www.knot-resolver.cz/

cz.nic

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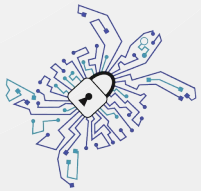
knot-resolver 4.0.0

- released on 2019-04-18

- DoH client → nginx → knot-resolver



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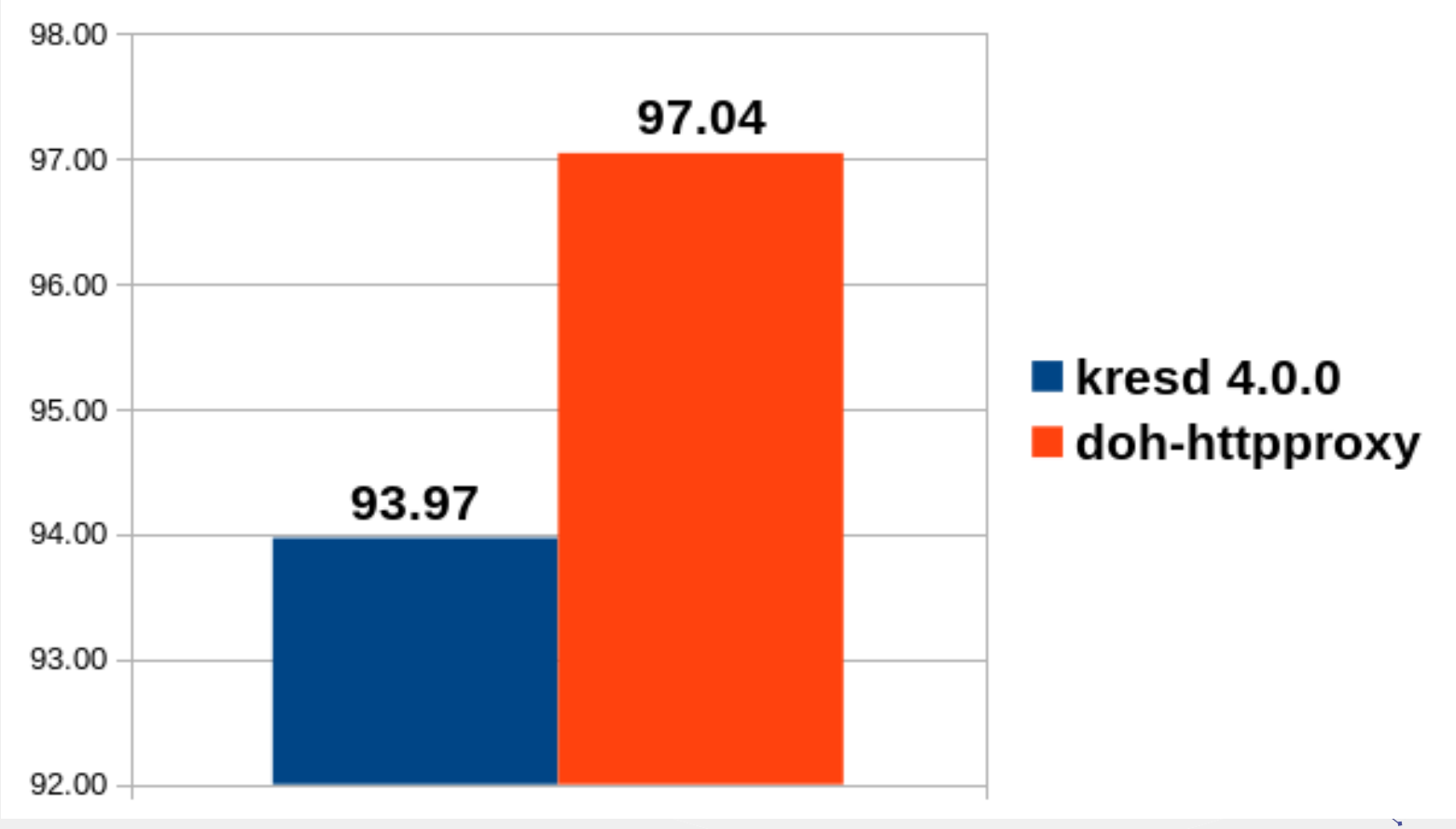
kresd vs. doh-httpproxy

What percentage of HTTP requests are answered with ‘200 OK’? (more = better)



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knot-resolver 4.0.0 HTTP parameter handling

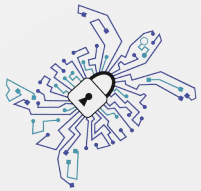
https://odvr.nic.cz/doh?dns=l1sBAAABAAAAAAAAA3d3dw1rbm90LXJlc29sdmVyAmN6AAAcAAE

200 OK

https://odvr.nic.cz/doh?
dns=l1sBAAABAAAAAAAAA3d3dw1rbm90LXJlc29sdmVyAmN6AAAcAAE**&ct**

400 Bad Request

Thread about HTTP parameter checking on the DoH working group mailing list:
https://mailarchive.ietf.org/arch/msg/doh/naLd8rVW1HWmghlCs6qmtNq-5RE



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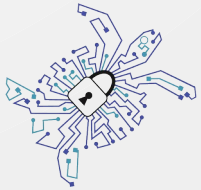
knot-resolver 4.0.0

Quote from knot-resolver developer Petr Špaček (cz.nic) from RIPE78 (2019-05-23):

“[...] we hate DoH implementation so please don’t use it.”

https://ripe78.ripe.net/archives/video/127/ (@ 18:13sec)



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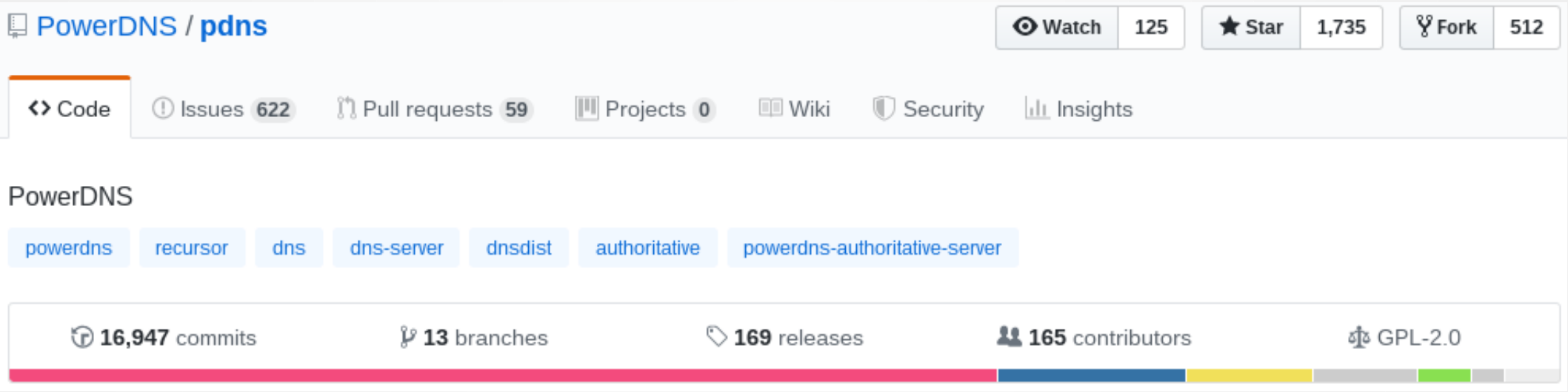
dnsdist



https://dnsdist.org

POWERDNS

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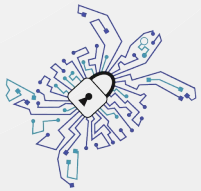
dnsdist 1.4.0-alpha2

- released on 2019-04-26
- DoH client → dnsdist → unbound



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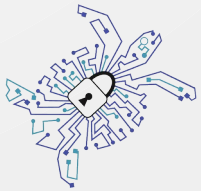
dnsdist 1.4.0-alpha2

```
May 12 21:12:08  kernel: dnsdist/doh[11118]: segfault at 7fe0440af5a8 ip 0000560e7c0f1d98 sp
May 12 21:12:08  kernel: Code: de 97 cf ff e9 a1 00 d7 ff 48 89 c5 e9 af 00 d7 ff 48 89 c5 e9
May 12 21:12:08  systemd[1]: dnsdist.service: Main process exited, code=killed, status=11/SEG
May 12 21:12:08  systemd[1]: dnsdist.service: Failed with result 'signal'.
May 12 21:12:10  systemd[1]: dnsdist.service: Service RestartSec=2s expired, scheduling resta
May 12 21:12:10  systemd[1]: dnsdist.service: Scheduled restart job, restart counter is at 1.
May 12 21:12:10  systemd[1]: Stopped DNS Loadbalancer.
May 12 21:12:10  systemd[1]: Starting DNS Loadbalancer...
May 12 21:12:10  dnsdist[18854]: Configuration '/etc/dnsdist/dnsdist.conf' OK!
[...]
```

Fixed in <24 hours after submitting issue



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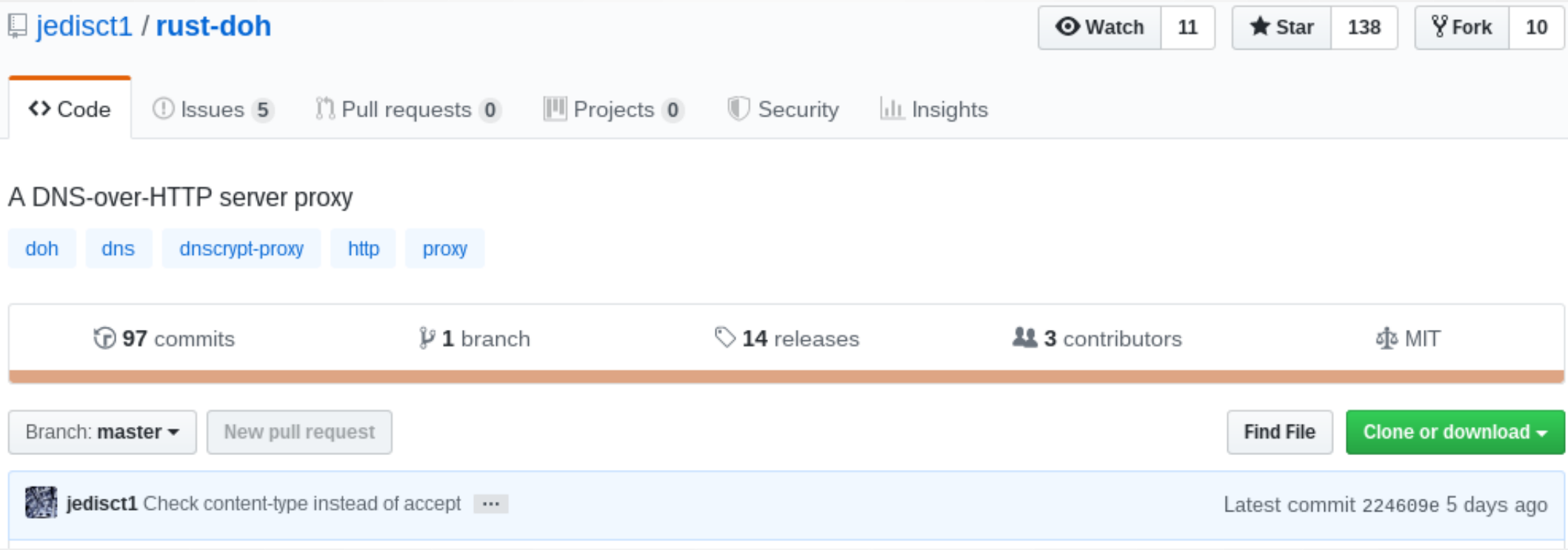
rust-doh



https://github.com/jedisct1/rust-doh

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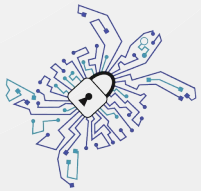
rust-doh

- nginx → rust-doh → unbound
- faster/less CPU usage than doh-httproxy
- no proper HTTP return codes (i.e. connection teardown instead of return code ‘400 Bad Request’)

  https://github.com/jedisct1/rust-doh/issues/20



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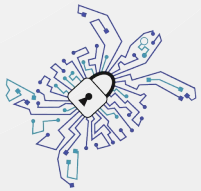
dnsdist 1.4.0-beta1

- released on 2019-06-06

- includes fix for previously reported crashes (#7810)



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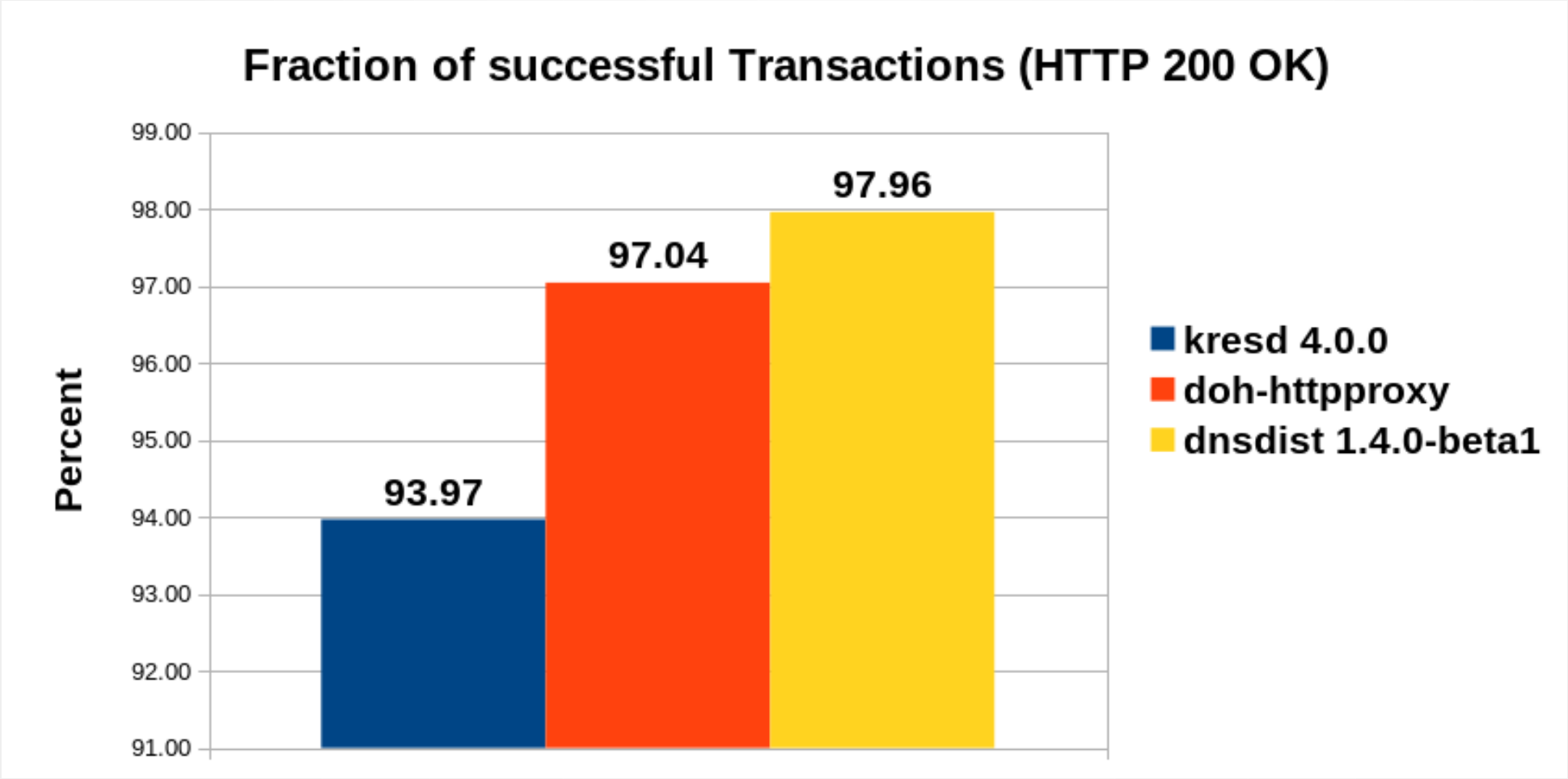
kresd vs. doh-httpproxy vs. dnsdist 1.4.0-beta1



sample size: 1 000 000 HTTP requests for each DoH server

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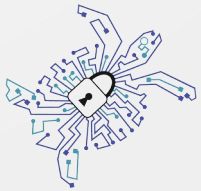
dnsdist

- easy installation: repositories for Debian/ CentOS/SUSE...
- libh2o (supports HTTP/1.x and HTTP/2)
- SNI based matching



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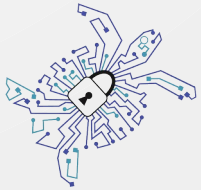
dnsdist feature requests

- HTTP header (CORS) (#7900)
- OCSP Stapling (#7812)
- HTTP response code stats (#7898)

https://github.com/PowerDNS/pdns/issues/created_by/appliedprivacy



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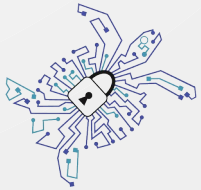
unbound

DoH implementation planned for second half of 2019



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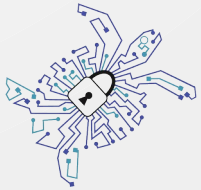
Summary

- **dnsdist** is (currently) the best option and becoming production ready

- run DoH and DoT services to help prevent centralization



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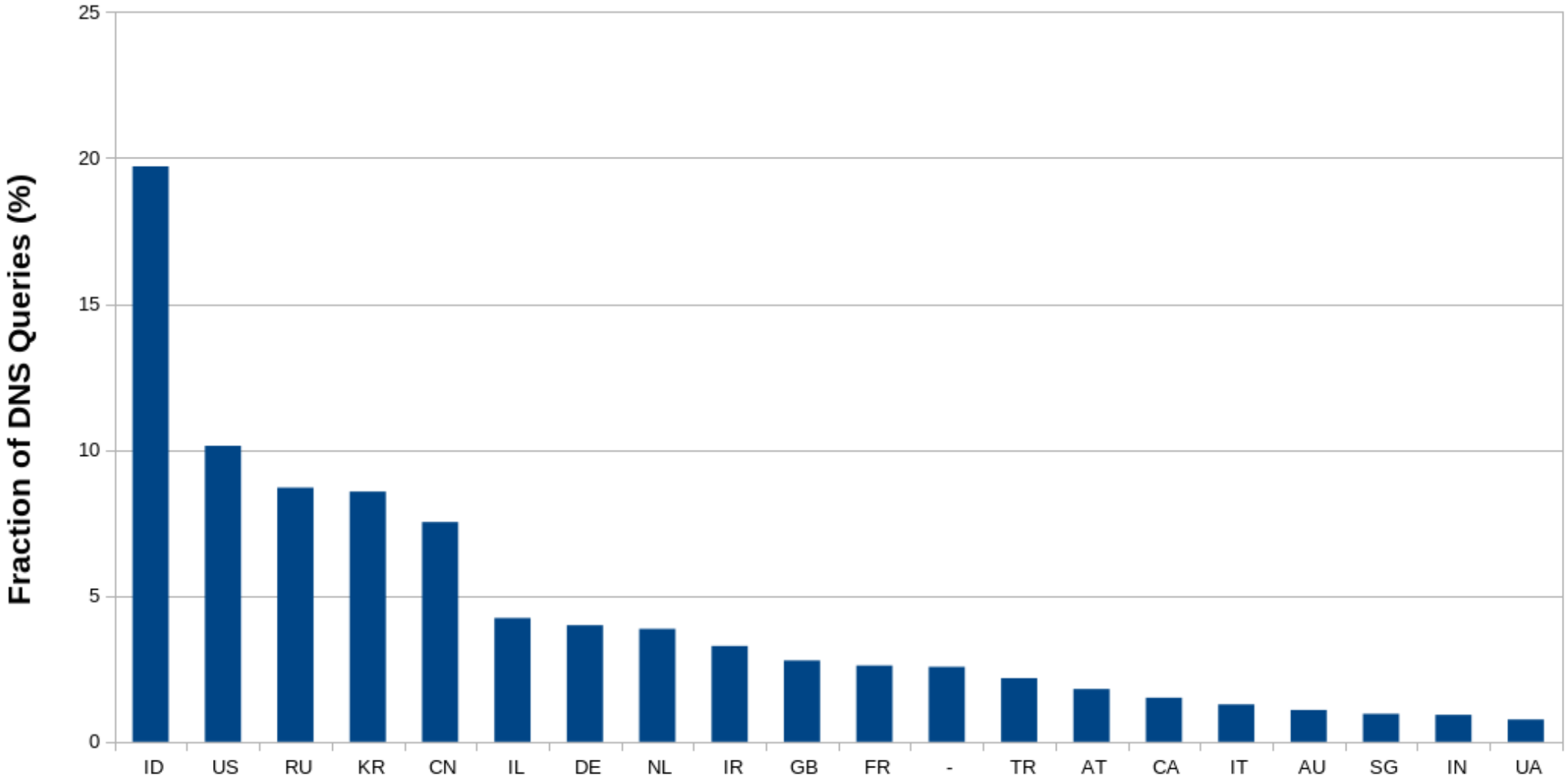
Top 20 Countries using DoH.appliedprivacy.net



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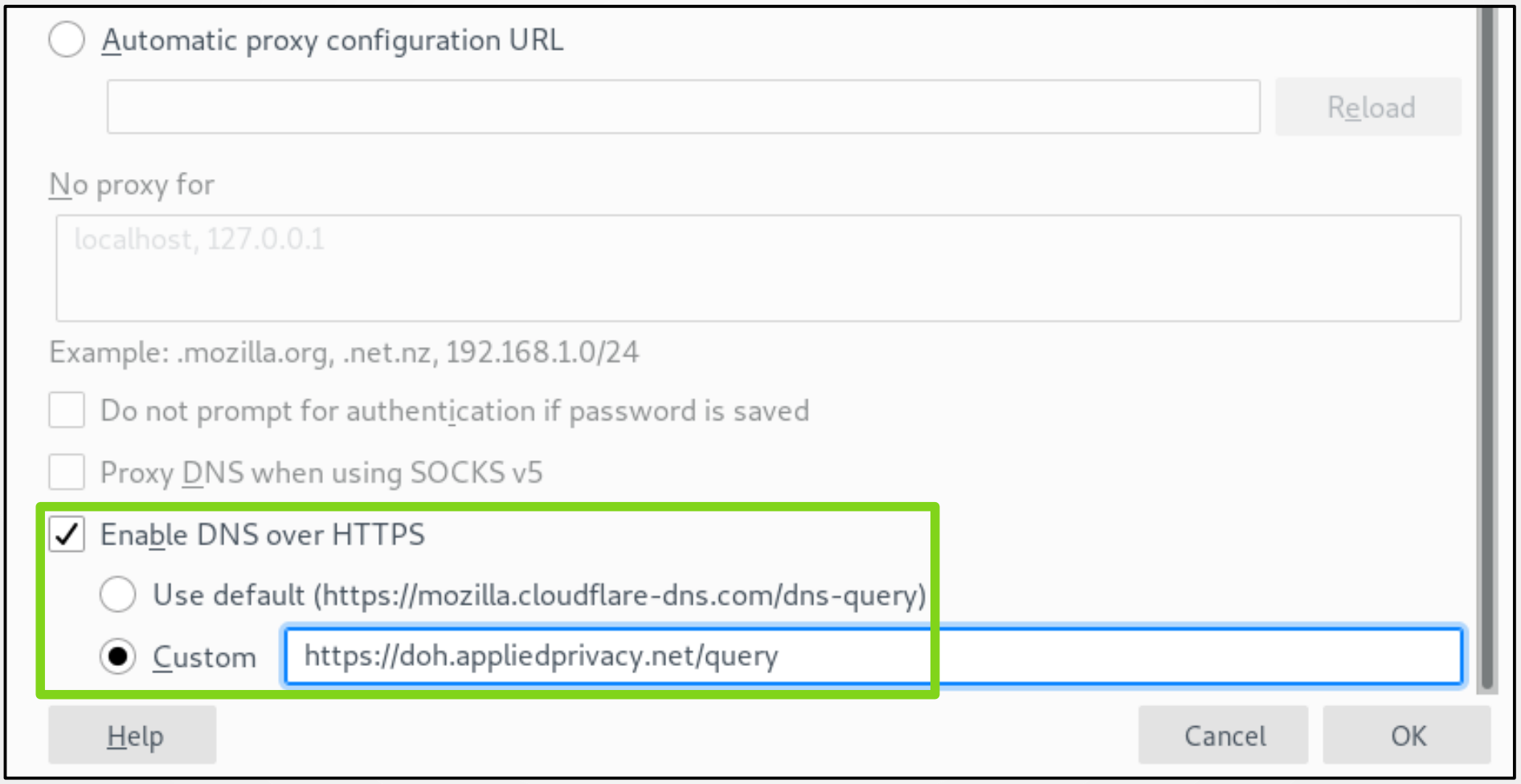
Using DoH with Firefox



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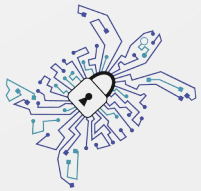
Our DoH/DoT DNS resolvers

https://doh.appliedprivacy.net/query

dot1.appliedprivacy.net



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Questions?

contact@appliedprivacy.net

Twitter: @applied_privacy

https://appliedprivacy.net

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