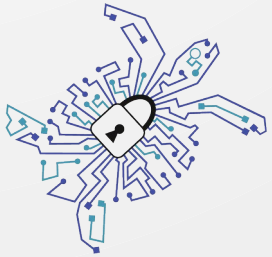
DoH, DoT, what?

Eine Einführung in die DNS Privacy Protokolle DoH und DoT.



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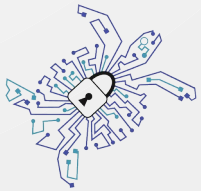
- Non-profit Privacy Infrastruktur Provider
- PETS Dienste für die Öffentlichkeit
- 2018 gegründet
- Top 3 Tor Exit Relay Operator (weltweit)
- > 2000 Terabyte monatlicher Netzwerkverkehr



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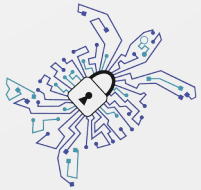
Ziele dieses Vortrags

- Welches Problem lösen DoH/DoT?
- Wie ist DoT und DoH aufgebaut?
- Welche Software gibts?
- Kritikpunkte



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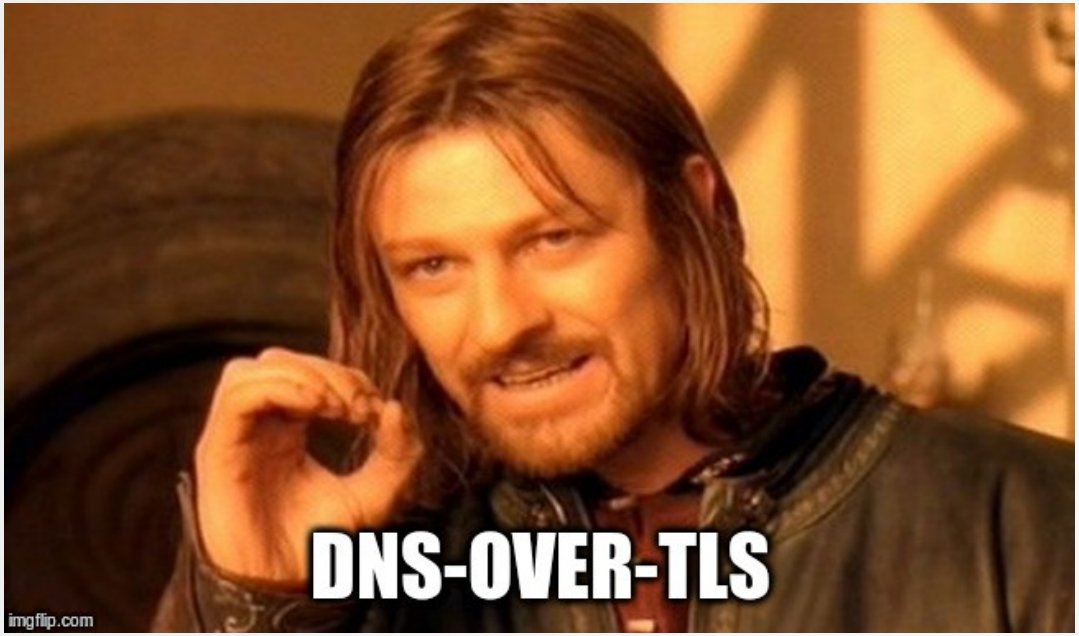
Ziele dieses Vortrags



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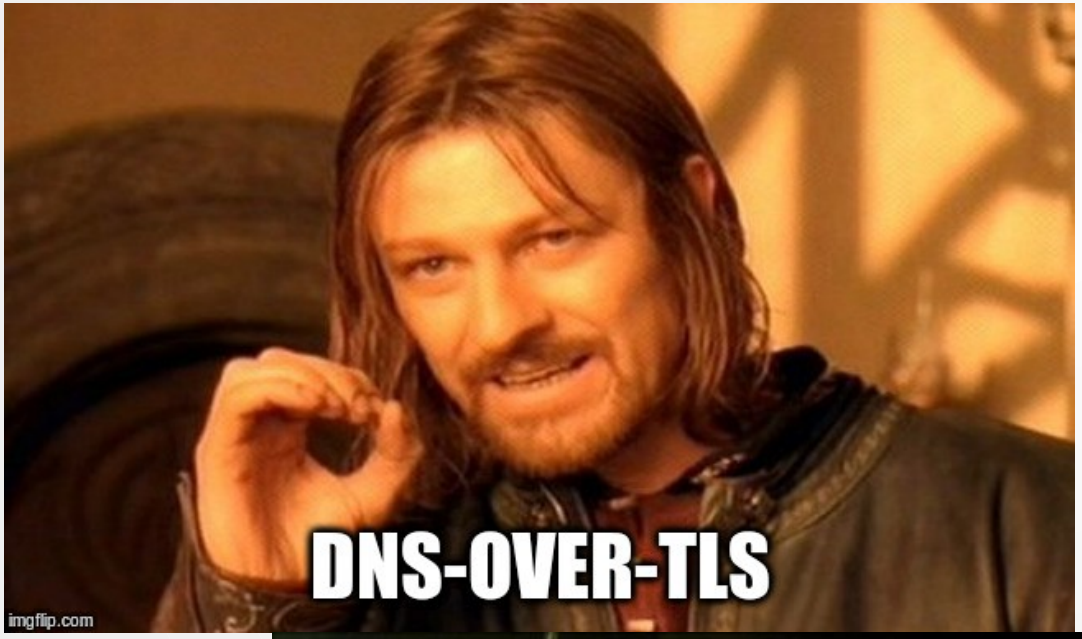

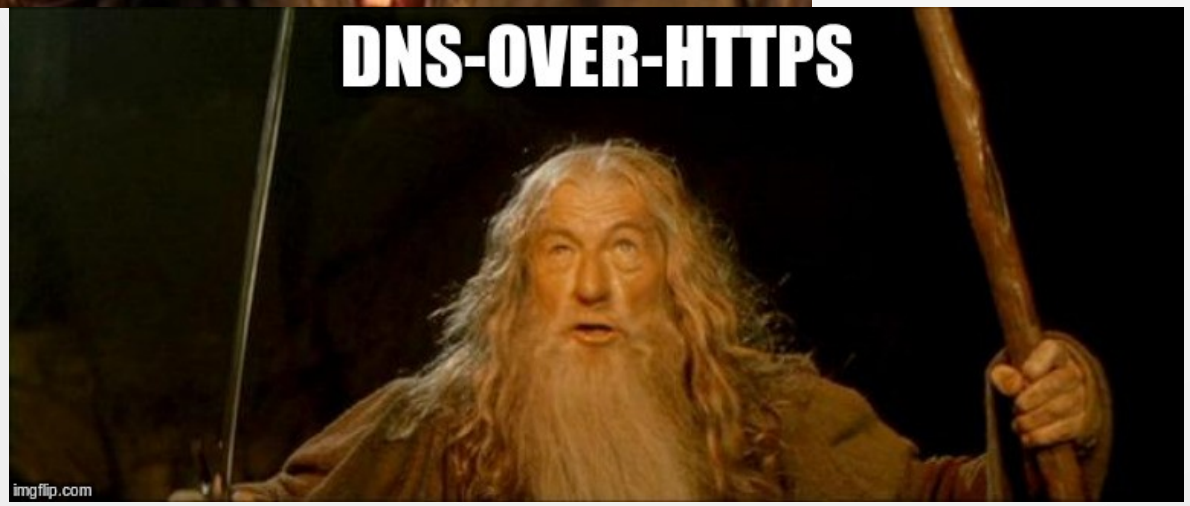

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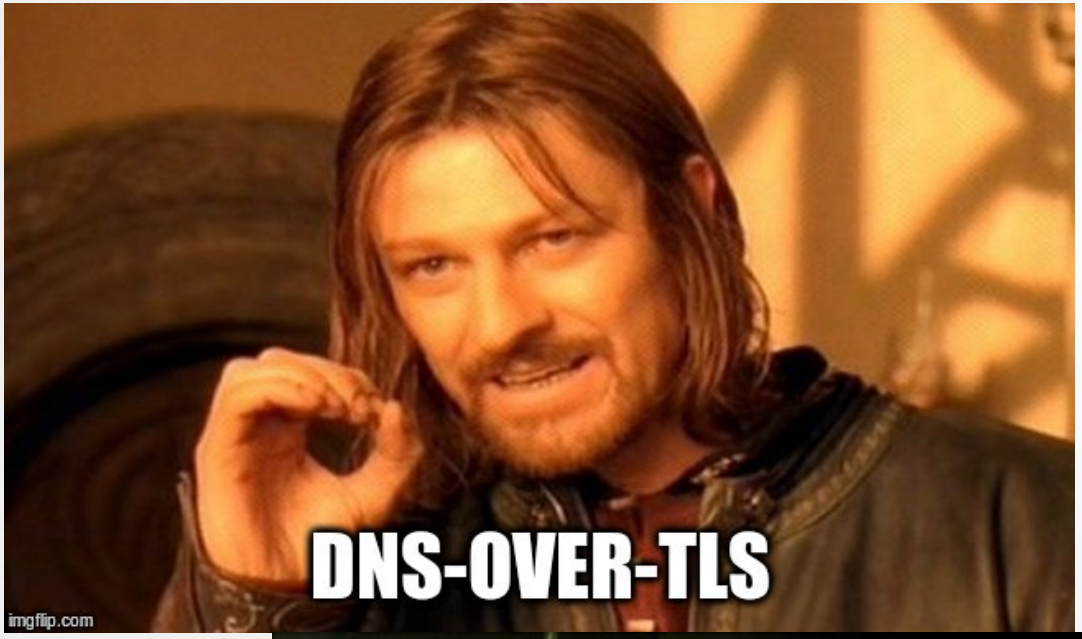
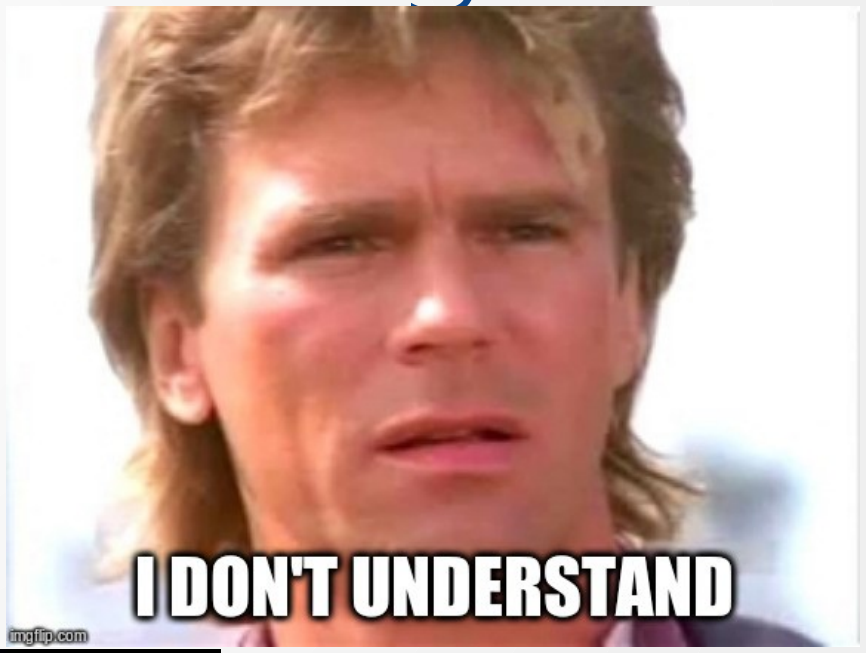
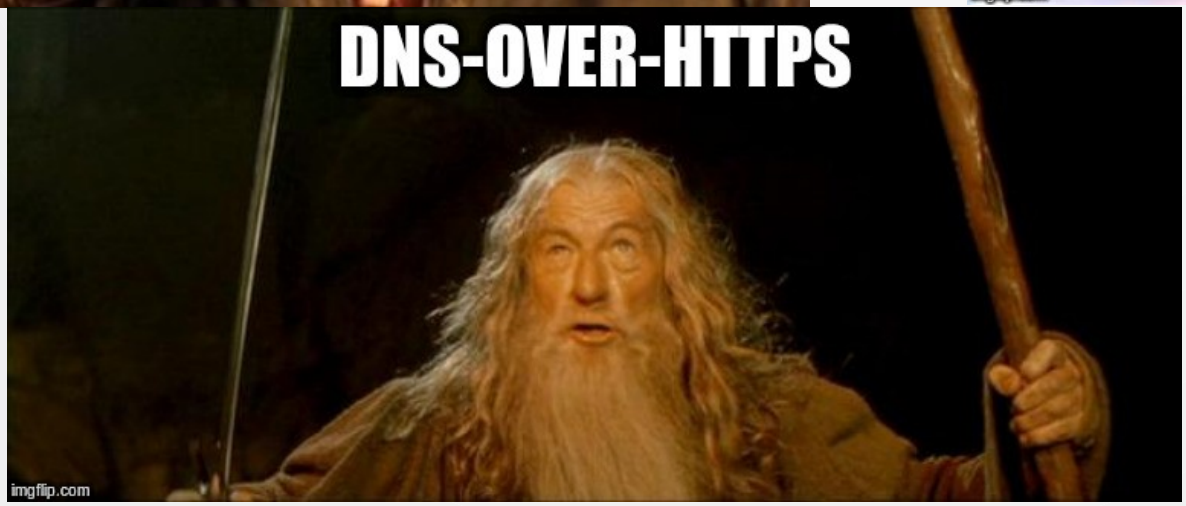
Ziele dieses Vortrags







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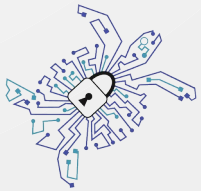
Warum DNS Privacy?



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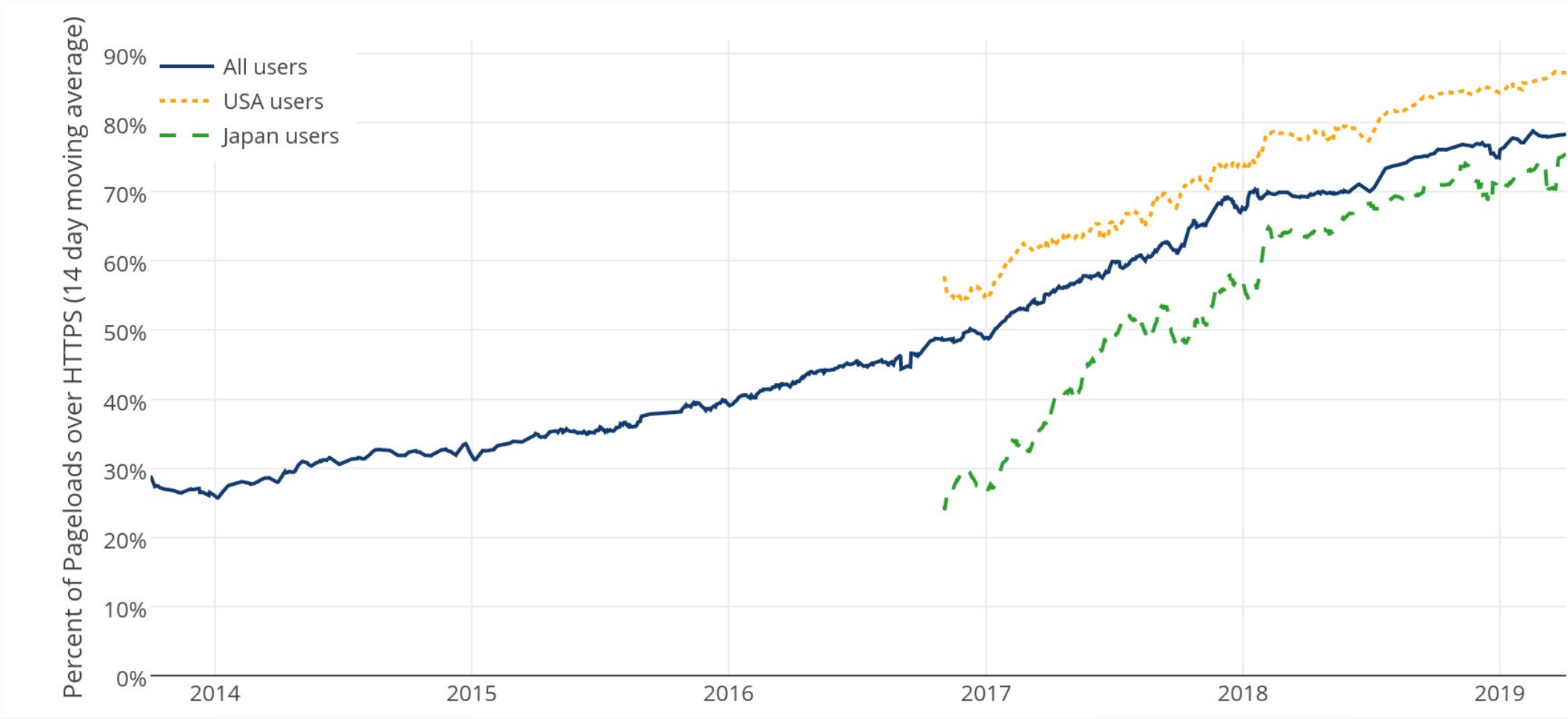
(14-day moving average, source: Firefox Telemetry)



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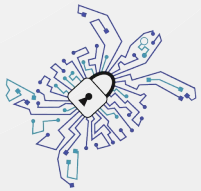
Ziel

Schutz von Metadaten (Hostname)



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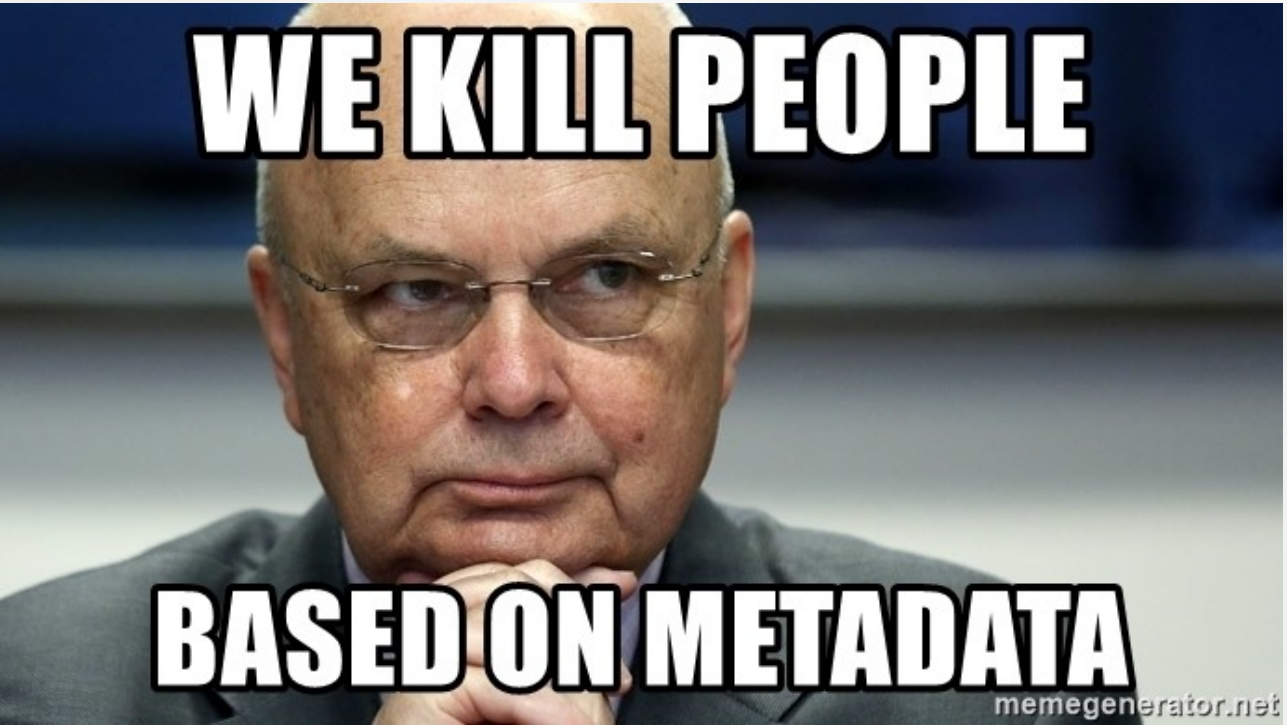
Warum ist das wichtig?

- Ermöglicht privateres browsen
- Erschwert Zensur
- Erschwert Massenüberwachung



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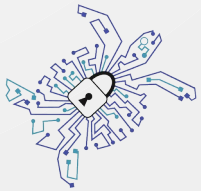
Warum ist das aktuell noch nicht möglich?

(ohne Torbrowser)



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User/Browser

de.wikipedia.org
Webserver

DNS
Resolver

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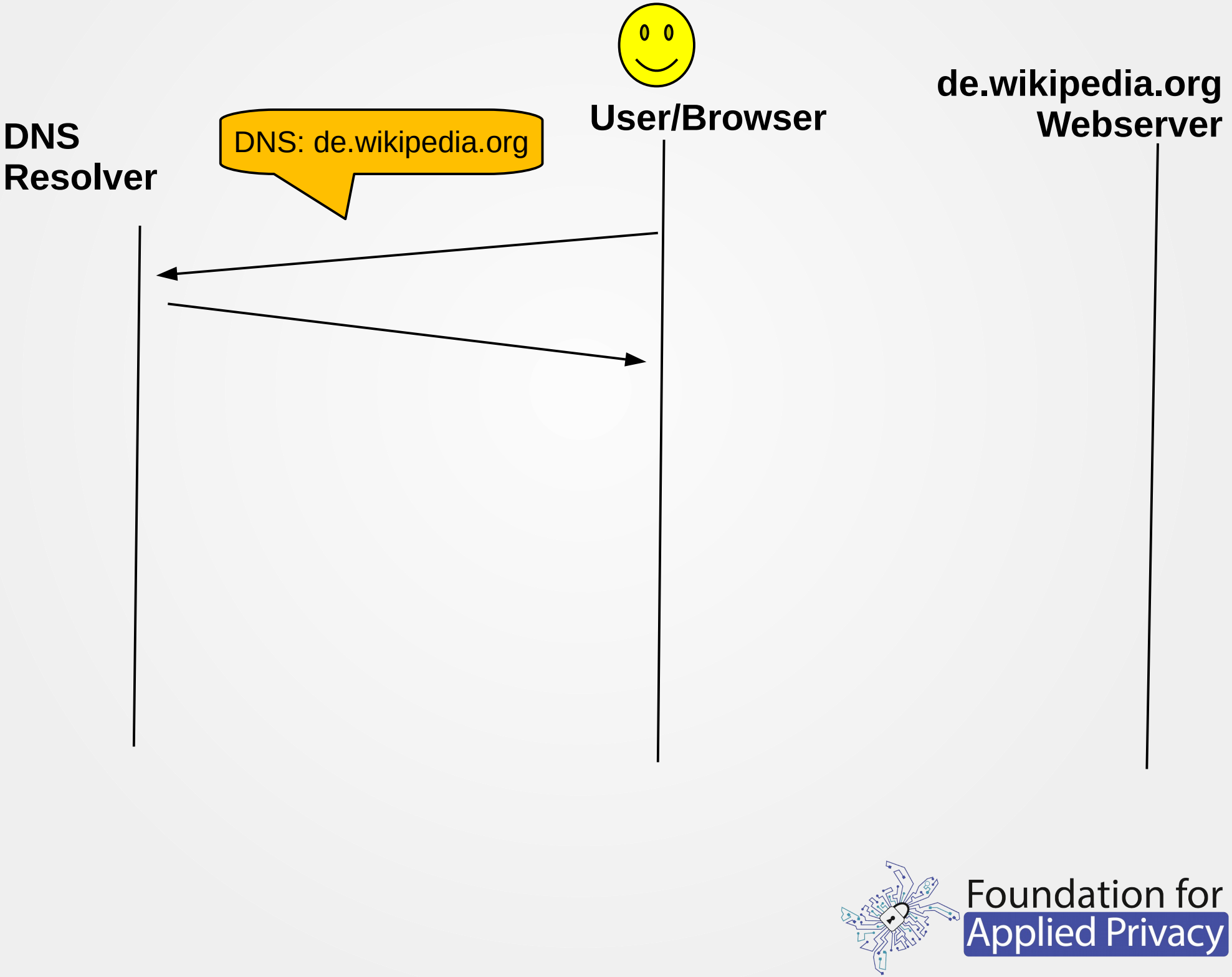

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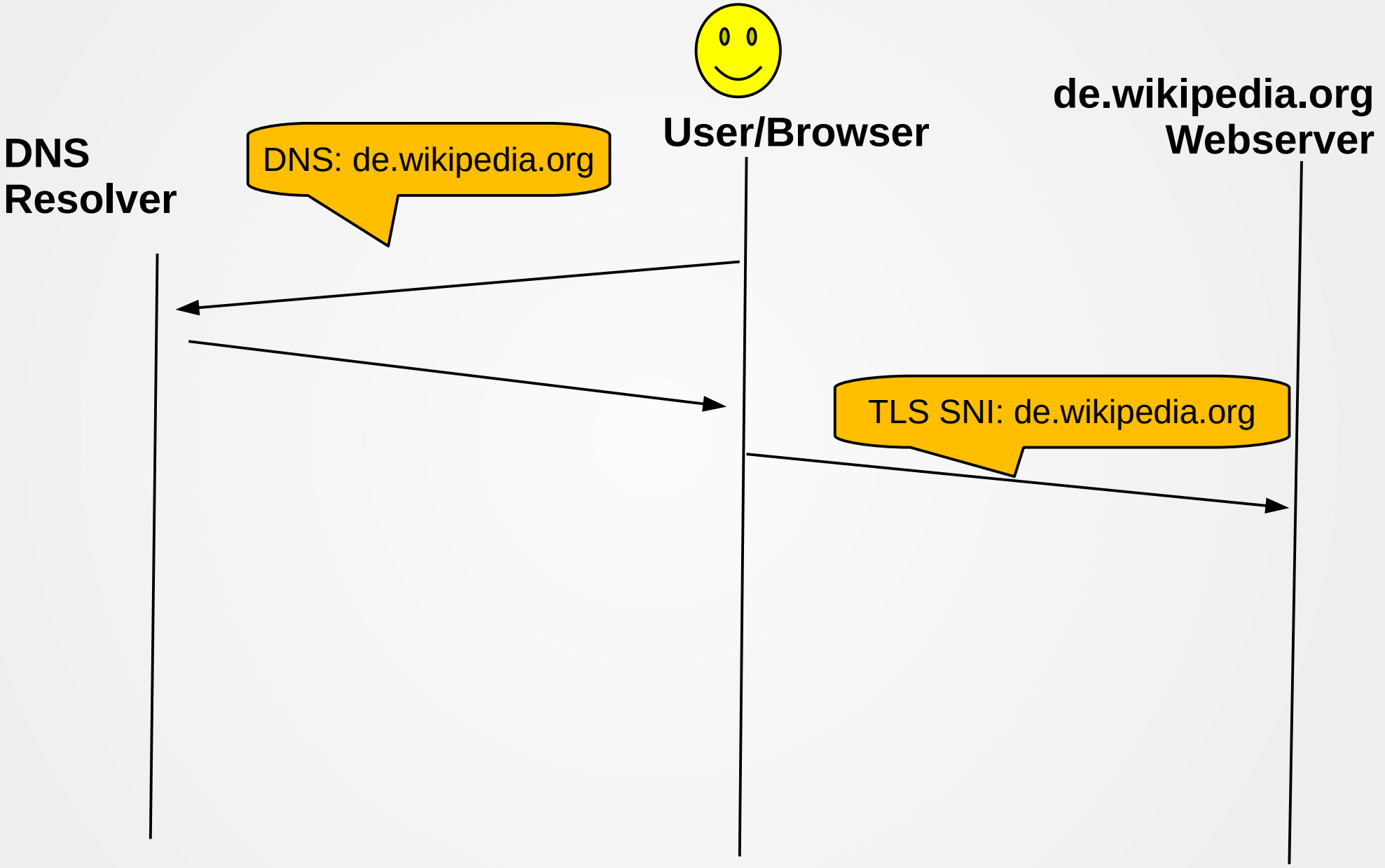

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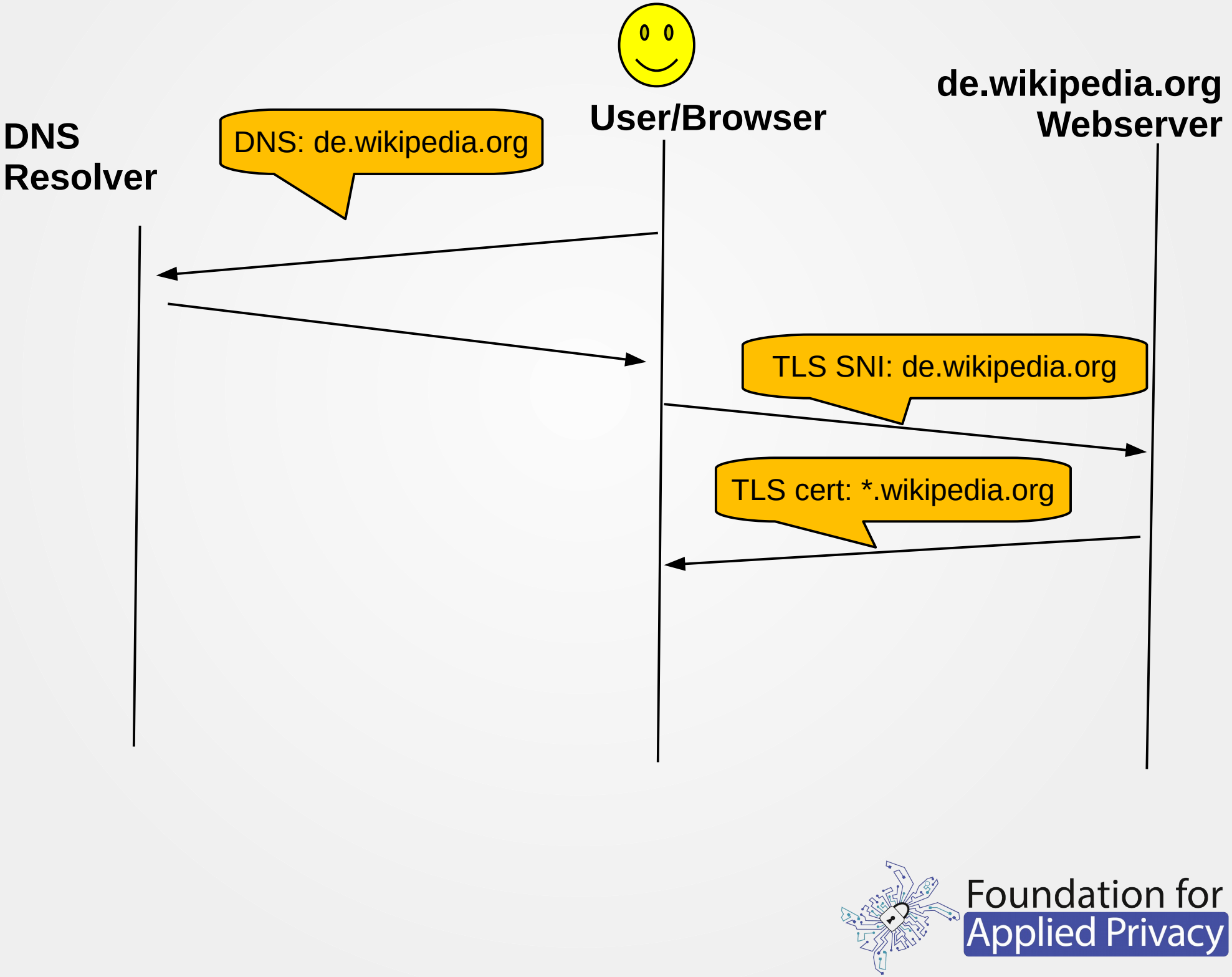

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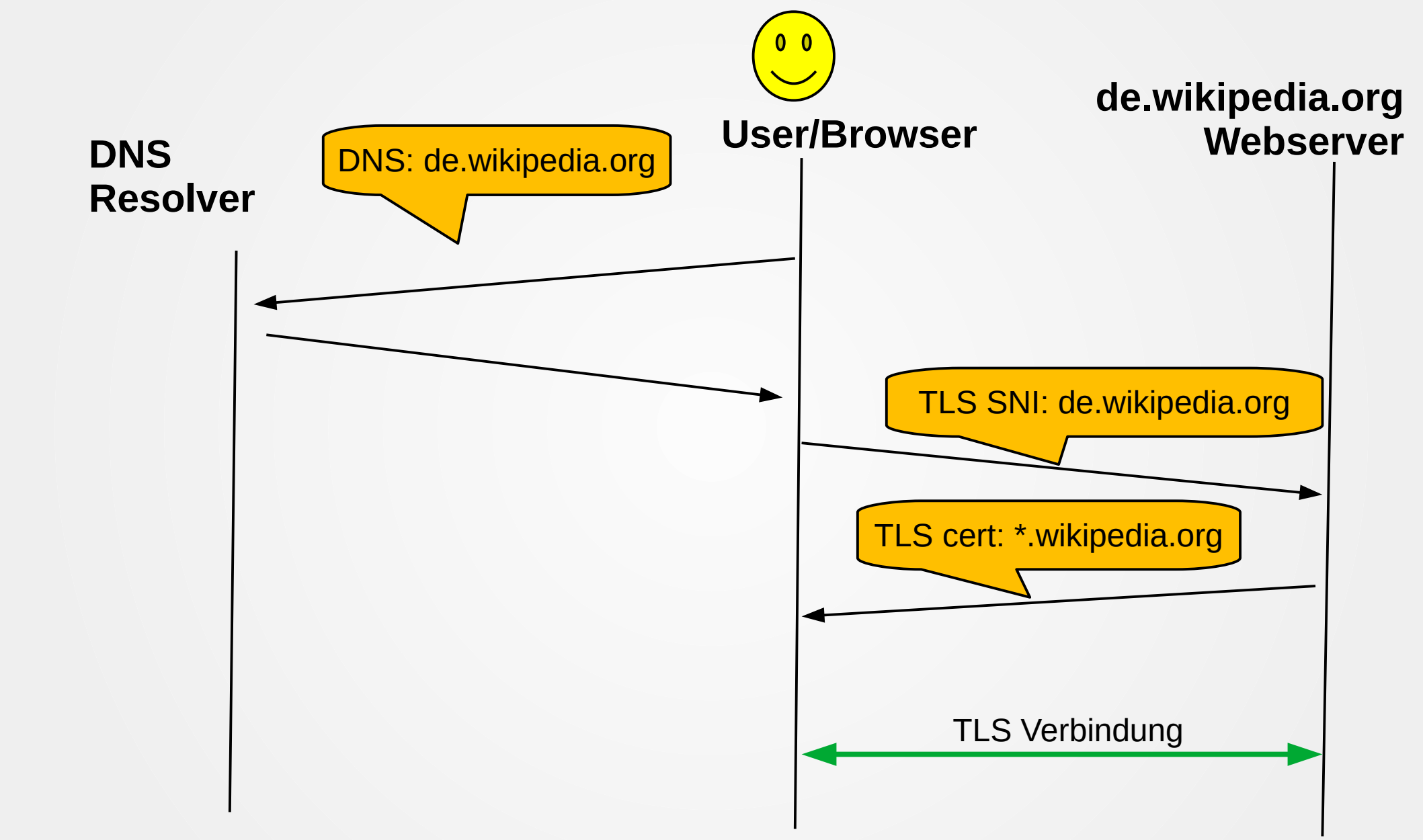

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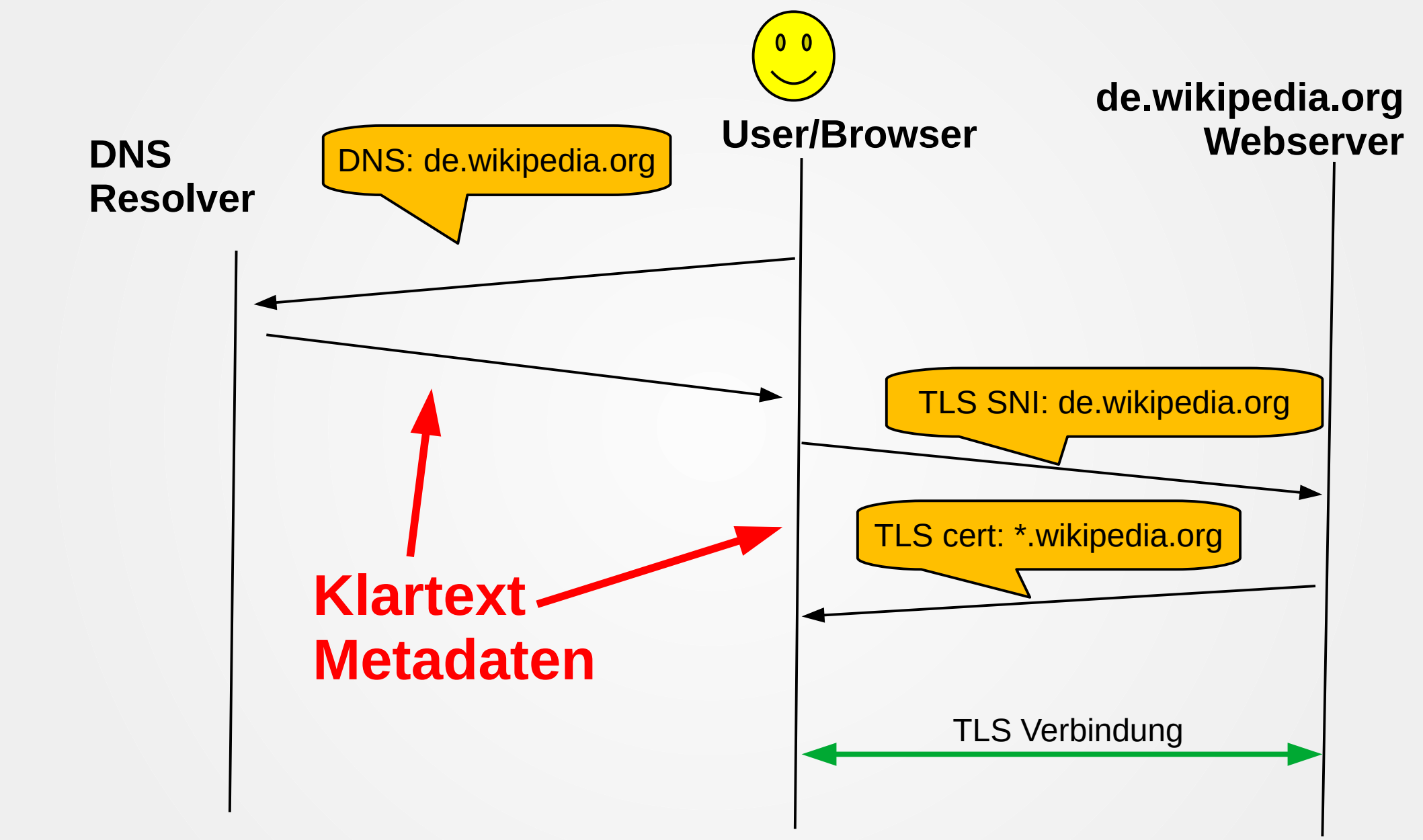

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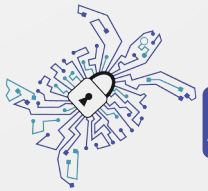
Source	Destination	Protocol	Info
10.137.0.12	10.139.1.1	DNS	Standard query 0x0f9d A de.wikipedia.org
10.137.0.12	10.139.1.1	DNS	Standard query 0x68a0 AAAA de.wikipedia.org
10.139.1.1	10.137.0.12	DNS	Standard query response 0x0f9d A de.wikipedia.org
10.139.1.1	10.137.0.12	DNS	Standard query response 0x68a0 No such name AAAA d
10.137.0.12	91.198.174.192	TCP	59194 → 443 [SYN] Seq=0 Win=29200 Len=0 MSS=1460 S
91.198.174.192	10.137.0.12	TCP	443 → 59194 [SYN, ACK] Seq=0 Ack=1 Win=29200 Len=0
10.137.0.12	91.198.174.192	TCP	59194 → 443 [ACK] Seq=1 Ack=1 Win=29312 Len=0
10.137.0.12	91.198.174.192	TLSv1.2	Client Hello
91.198.174.192	10.137.0.12	TCP	443 → 59194 [ACK] Seq=1 Ack=518 Win=30272 Len=0
91.198.174.192	10.137.0.12	TLSv1.2	Server Hello, Certificate
10.137.0.12	91.198.174.192	TCP	59194 → 443 [ACK] Seq=518 Ack=3487 Win=36224 Len=0
91.198.174.192	10.137.0.12	TLSv1.2	Certificate Status, Server Key Exchange, Server He
10.137.0.12	91.198.174.192	TCP	59194 → 443 [ACK] Seq=518 Ack=5107 Win=39424 Len=0
10.137.0.12	91.198.174.192	TLSv1.2	Client Key Exchange, Change Cipher Spec, Encrypted
91.198.174.192	10.137.0.12	TCP	443 → 59194 [ACK] Seq=5107 Ack=603 Win=30272 Len=0
10.137.0.12	91.198.174.192	TLSv1.2	Application Data



Foundation for Applied Privacy

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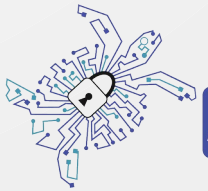

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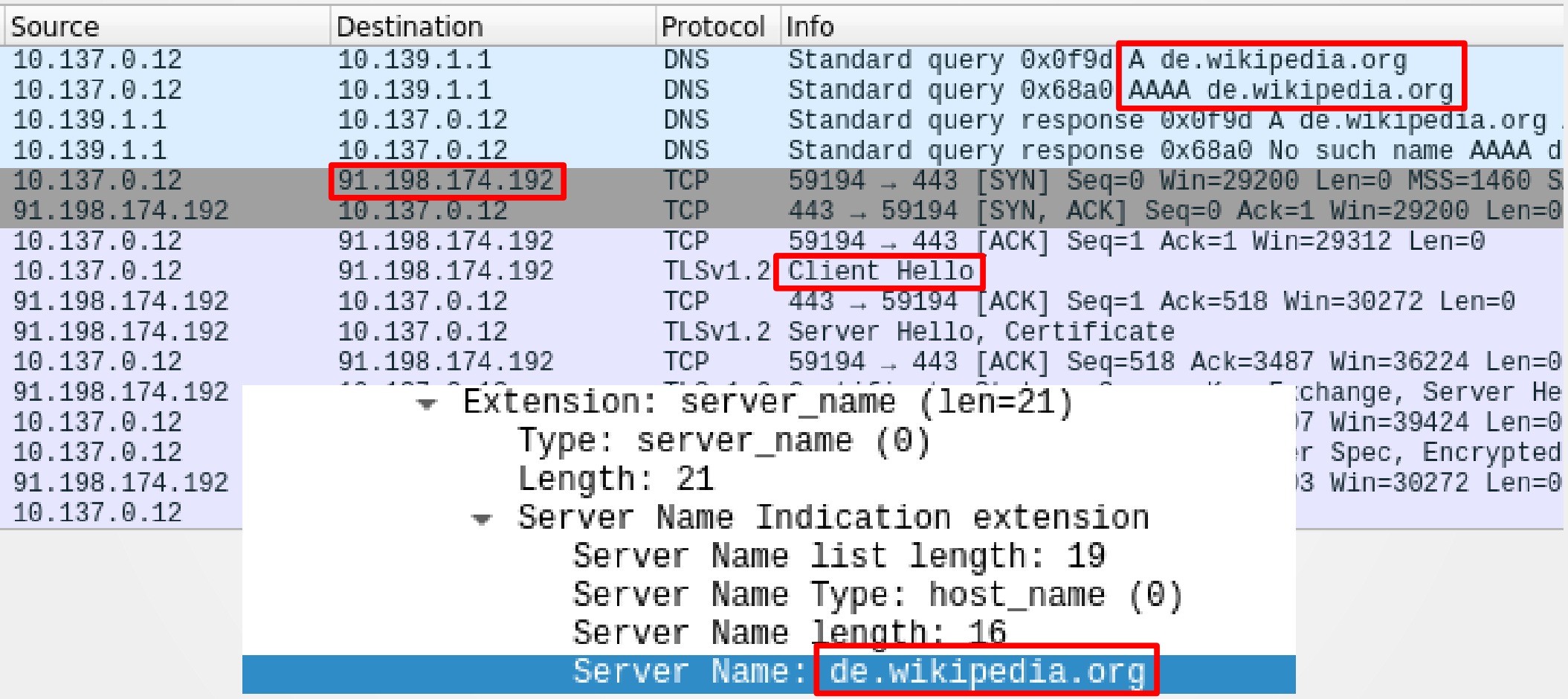

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10.137.0.12	91.198.174.192	TCP	59194 → 443 [ACK] Seq=518 Ack=5107 Win=39424 Len=0

```
Handshake Protocol: Certificate
    Handshake Type: Certificate (11)
    Length: 3236
    Certificates Length: 3233
  ▾ Certificates (3233 bytes)
      Certificate Length: 2101
    ▾ Certificate: 3082083130820719a003020102020c1640c5d45d2ec4d94c… (id-at-commonName=*.wikipedia.org,
      ▸ signedCertificate
      ▸ algorithmIdentifier (sha256WithRSAEncryption)
        Padding: 0
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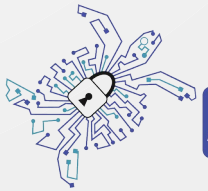

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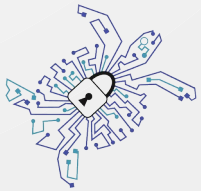
Problem/Leak	Lösung	Aufwand für Webseitbetreiber



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Problem/Leak	Lösung	Aufwand für Webseitbetreiber
IP Adresse	CDN/vHosts	~

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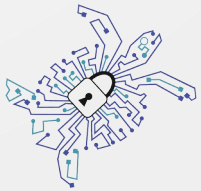
Problem/Leak	Lösung	Aufwand für Webseitbetreiber
IP Adresse	CDN/vHosts	~
TLS SNI	Work in Progress: Encrypted SNI (ESNI)	Aufwand gross (Webserver + DNS)



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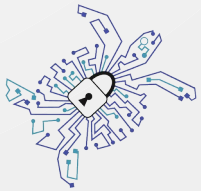
Problem/Leak	Lösung	Aufwand für Webseitbetreiber
IP Adresse	CDN/vHosts	~
TLS SNI	Work in Progress: Encrypted SNI (ESNI)	Aufwand gross (Webserver + DNS)
TLS Zertifikat	TLS 1.3	TLS 1.3 ausrollen



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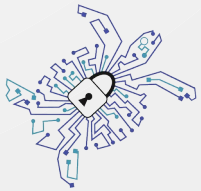
Problem/Leak	Lösung	Aufwand für Webseitbetreiber
IP Adresse	CDN/vHosts	~
TLS SNI	Work in Progress: Encrypted SNI (ESNI)	Aufwand gross (Webserver + DNS)
TLS Zertifikat	TLS 1.3	TLS 1.3 ausrollen
DNS	DoH/DoT/...	Kein Aufwand (Betreiber nicht involviert)



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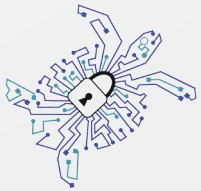
Problem/Leak	**Lösung**	**Aufwand für Webseitbetreiber**
IP Adresse	CDN/vHosts	~
TLS SNI	Work in Progress: Encrypted SNI (ESNI)	Aufwand gross (Webserver + DNS)
TLS Zertifikat	TLS 1.3	TLS 1.3 ausrollen
DNS	**DoH/DoT**/...	Kein Aufwand (Betreiber nicht involviert)



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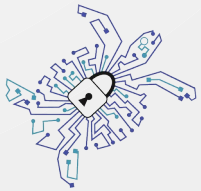
DNS



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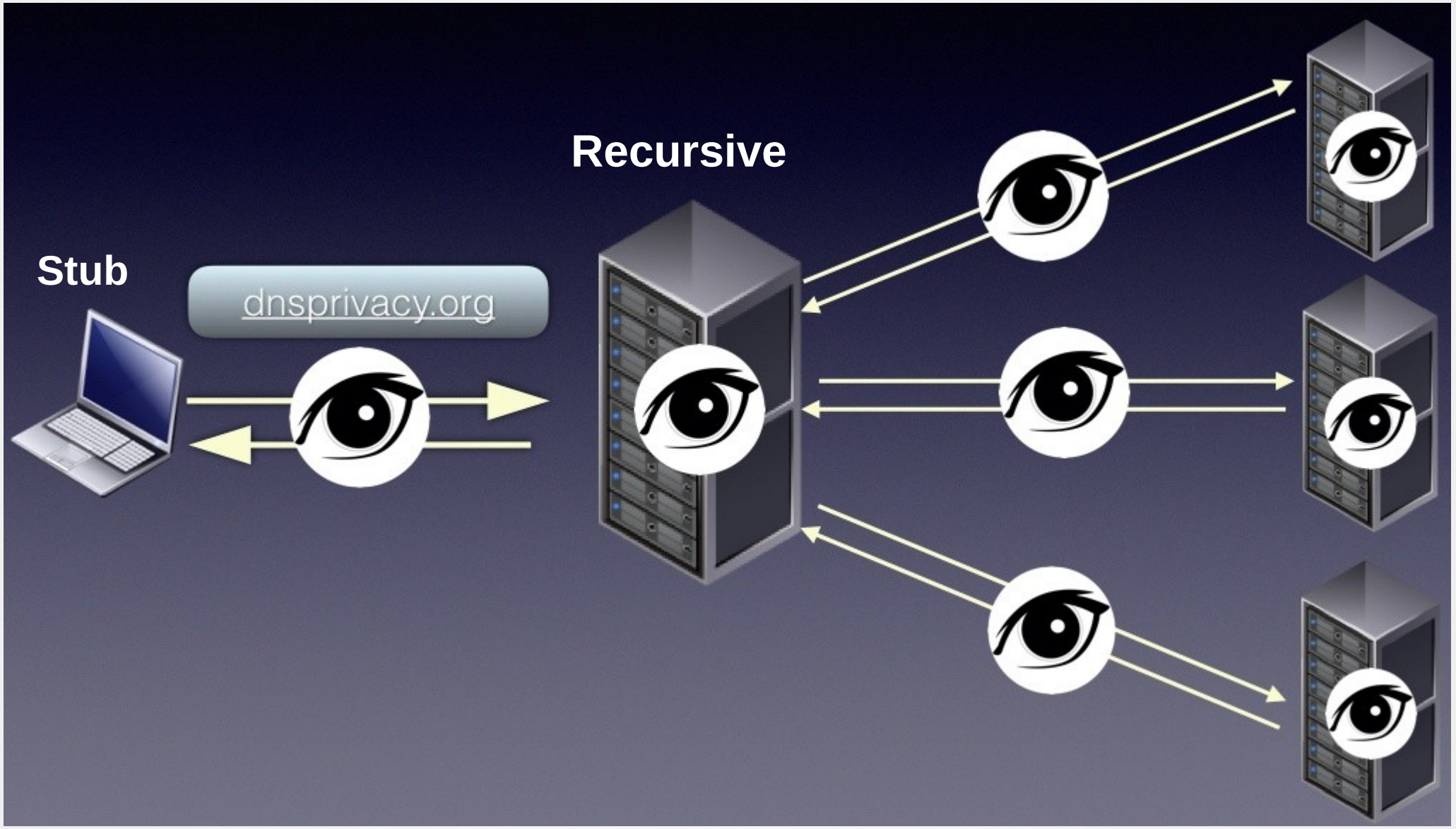
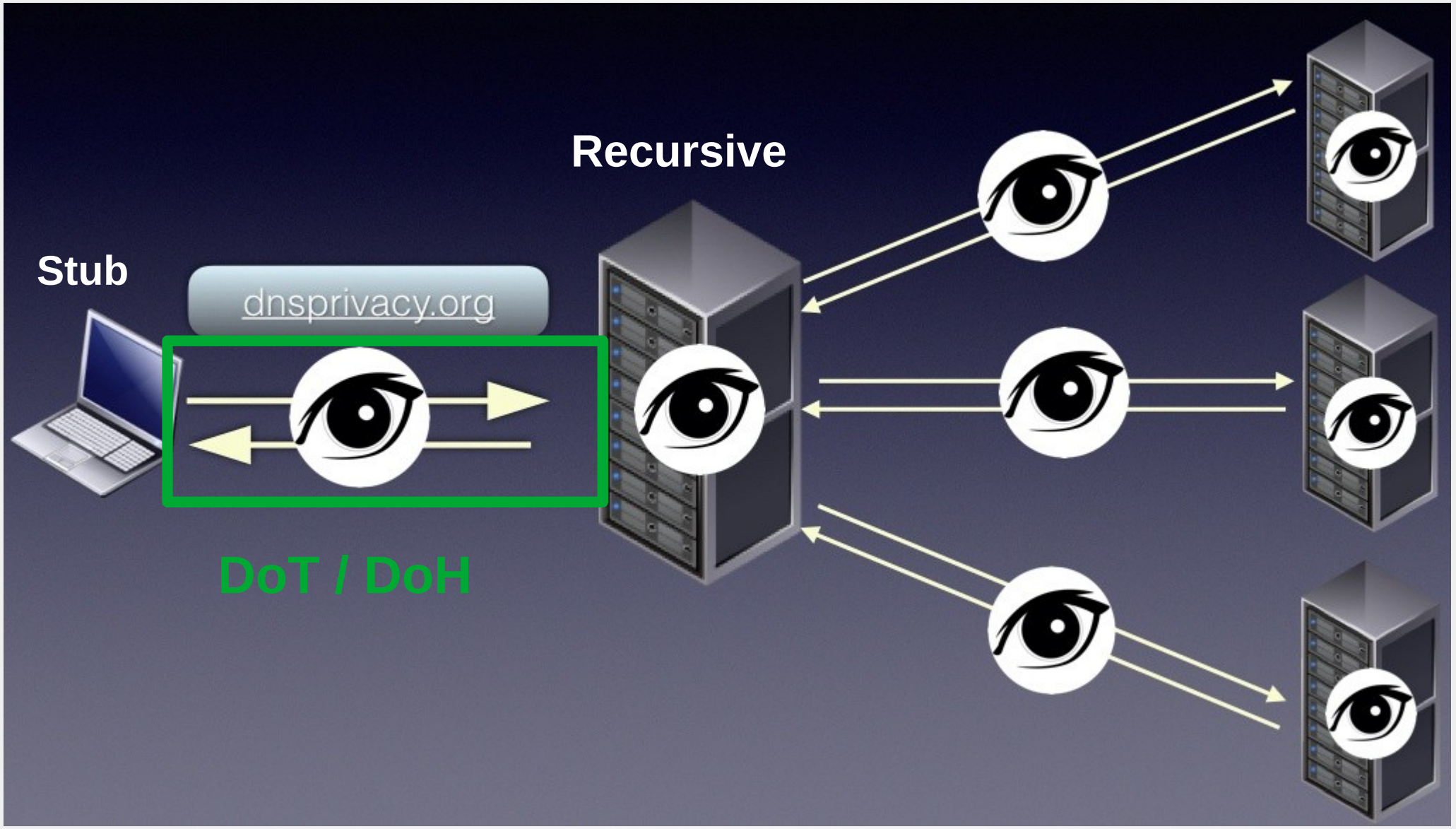
Applied Privacy



Quelle: dnsprivacy.org

Foundation for Applied Privacy



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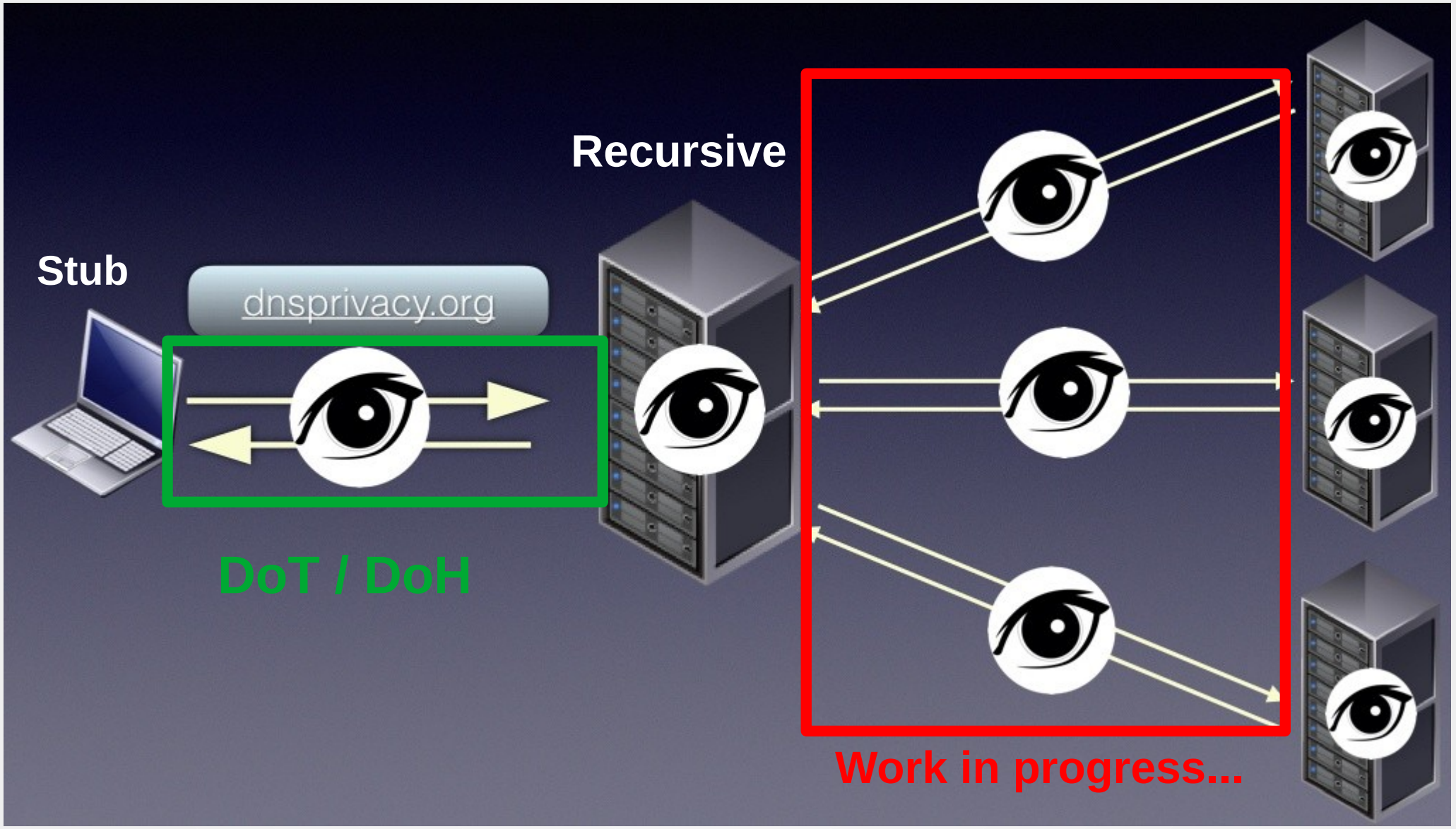
Foundation for Applied Privacy



Quelle: dnsprivacy.org

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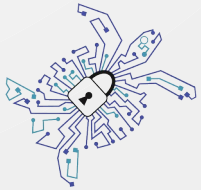
DNS-over-TLS (DoT)

RFC7858 (Mai 2016)
RFC8310 (März 2018)



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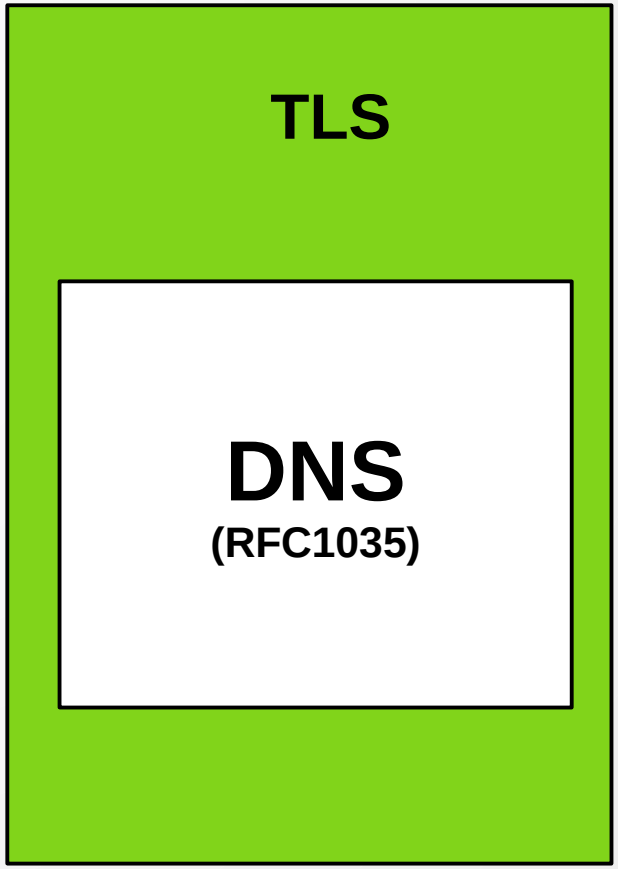
DoT

- >=TLS 1.2
- TCP Port 853
- inoffiziell auch beliebt: Port 443



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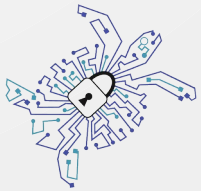
DoT Profile

- Opportunistisch



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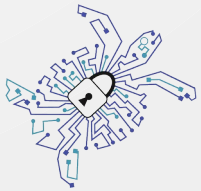
DoT Profile

- Opportunistisch

- Strikt
  - SPKI Pins
  - PKIX
  - DANE/TLSA



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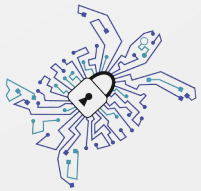
DoT Implementierungen (Client)

- **Stubby** (macOS, Windows, Linux)
- Android 9 Pie
- Knot-Resolver
- Unbound
- systemd-resolved (nur opportunistisch)



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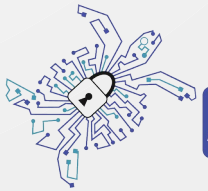
DoT Unbound (Client)



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DoT Unbound (Client)

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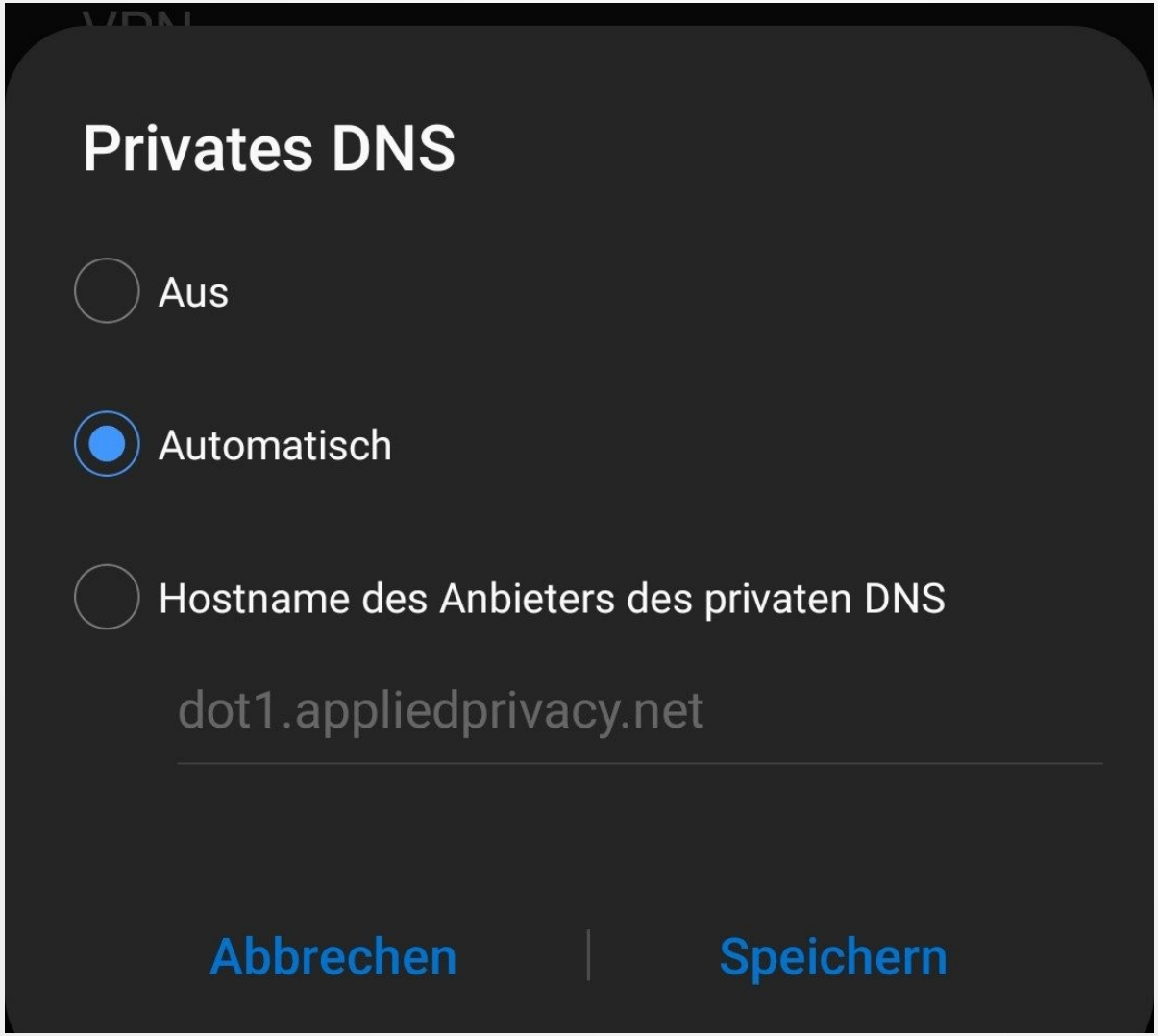
Android 9 “Automatisch” (default)



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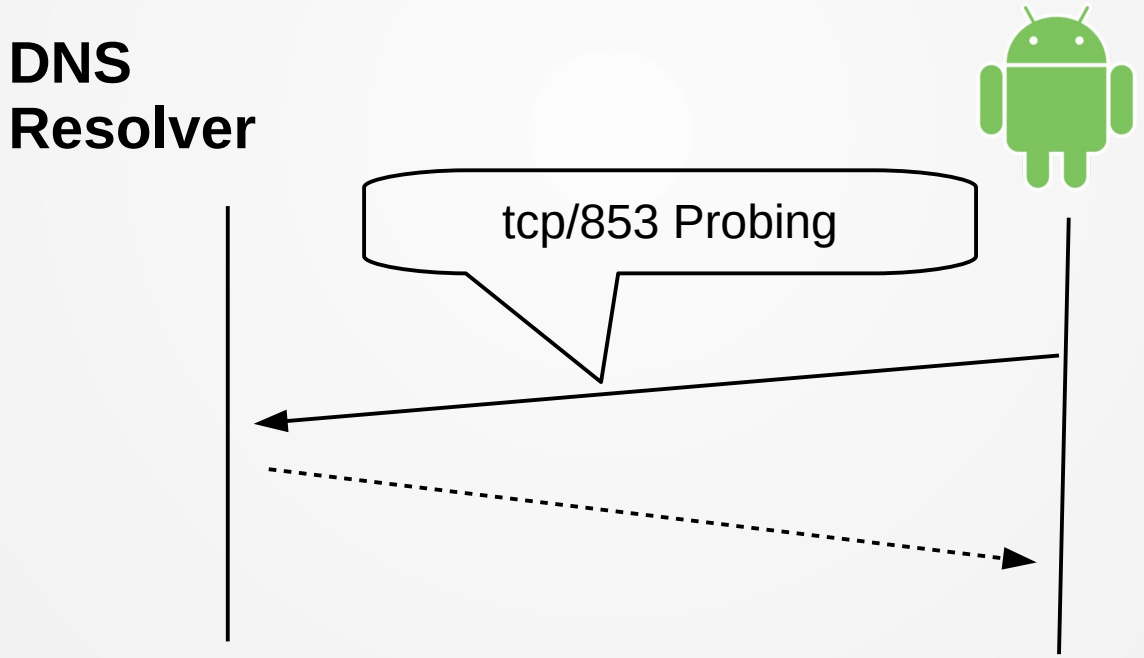
Android 9 "Automatisch" (default)



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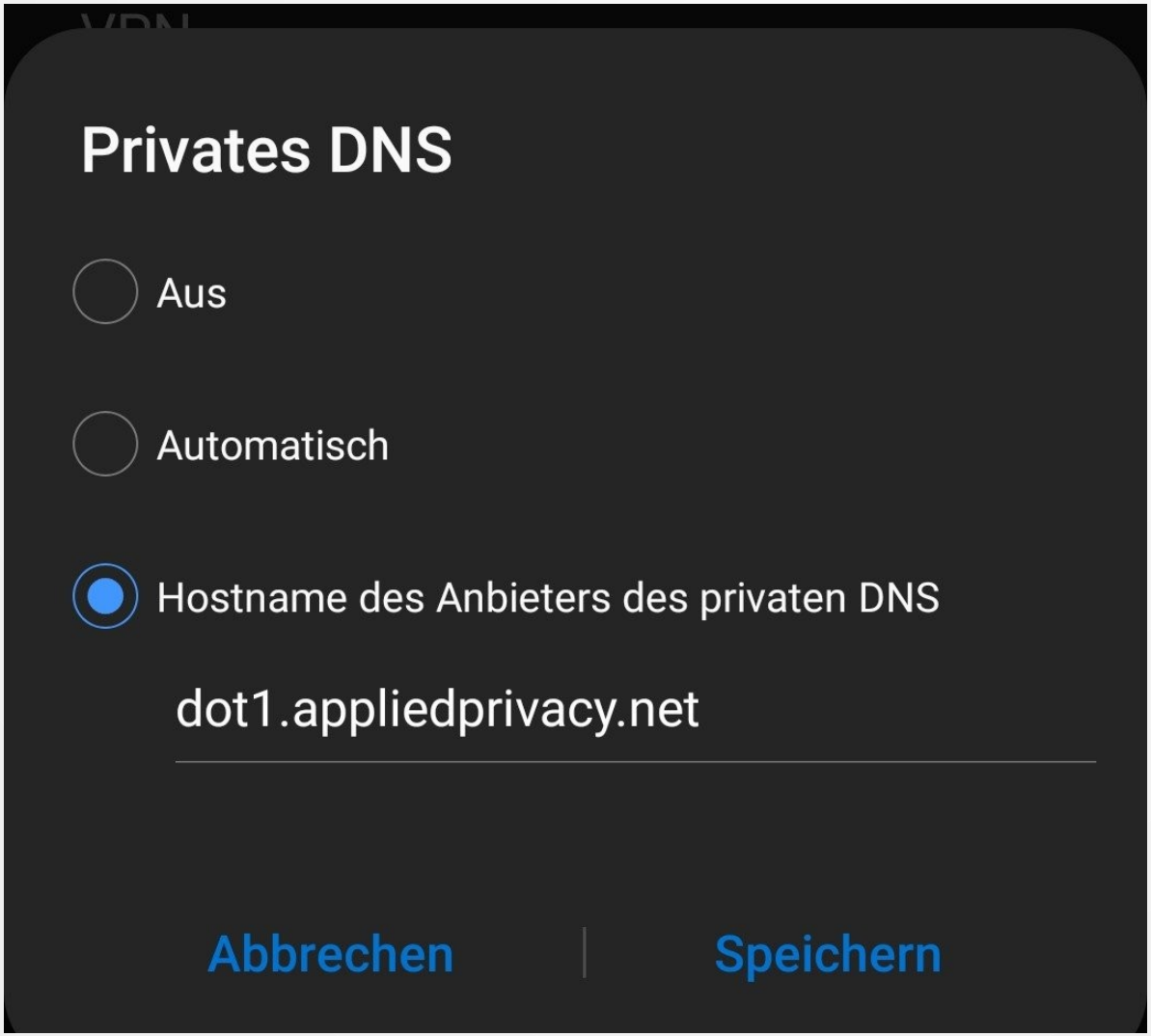
Android 9 strikt Mode



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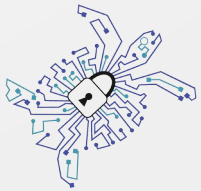
DoT Client Stubby

- **Opportunistisch oder strikt Mode**
- **TLS Connection Re-use**
- Pipelining, Out-of-Order Responses
- Explizites deaktivieren von EDNS Client Subnet
- DNS Padding, DNSSEC



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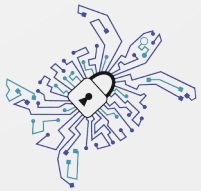
DoT Implementierungen (Server)

- Knot-Resolver (Padding)
- Unbound
- dnsdist
- BIND mit stunnel (Padding)



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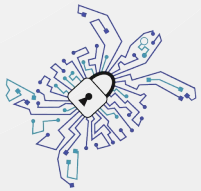
DNS-over-HTTPS (DoH)

RFC8484 (Okt 2018)



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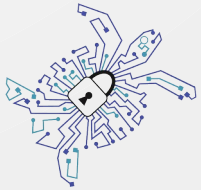
DoH - Motivation

- DNS gegen Middleboxen wappnen
- DNS Anfragen von Web Applikationen
- Proxy kompatibel
- Vor allem von Browser getrieben



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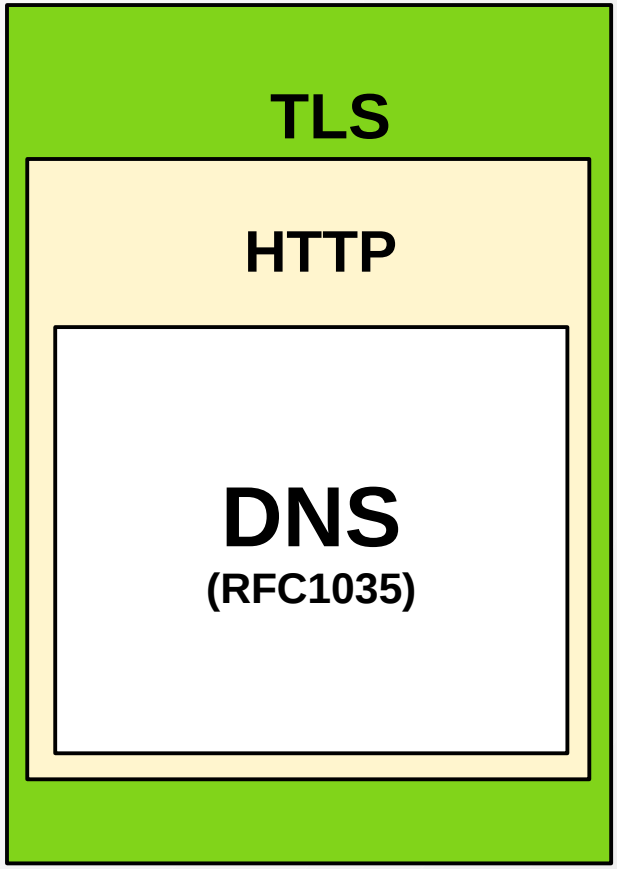
DoH

- HTTPS (443)
- **POST**
- oder GET (base64url)
- HTTP/2 (empfohlen)
- Content Type: application/dns-message



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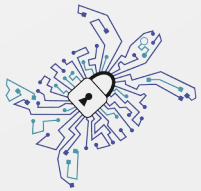
DoH Client Software

- Firefox
- Bromite (Android)
- Chrome (noch keine UI)
- dnscrypt-proxy (kann auch DoH)
  - DNSCloak (iOS)
  - Simple DNSCrypt (Windows)
- curl, ...



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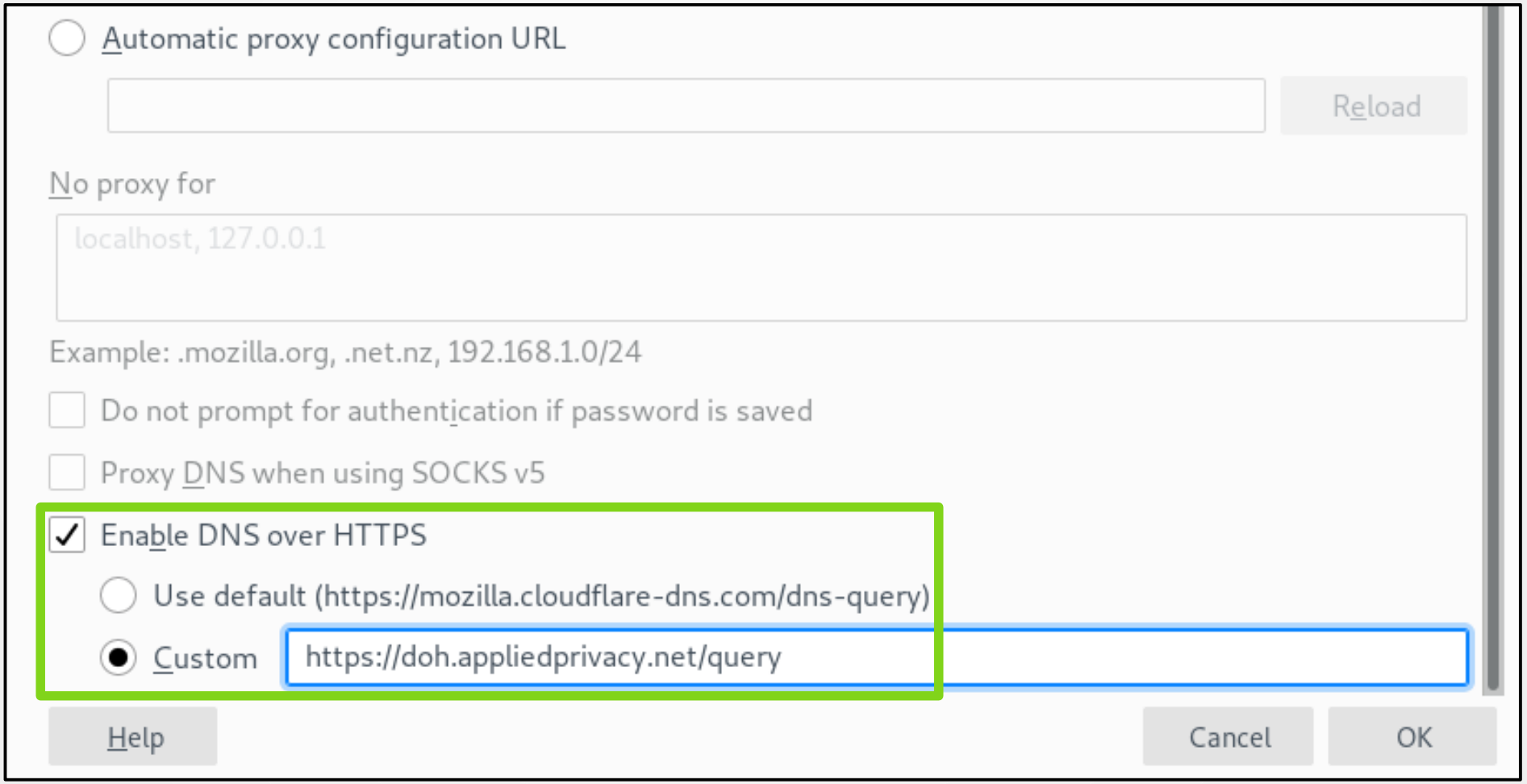
DoH mit Firefox nutzen



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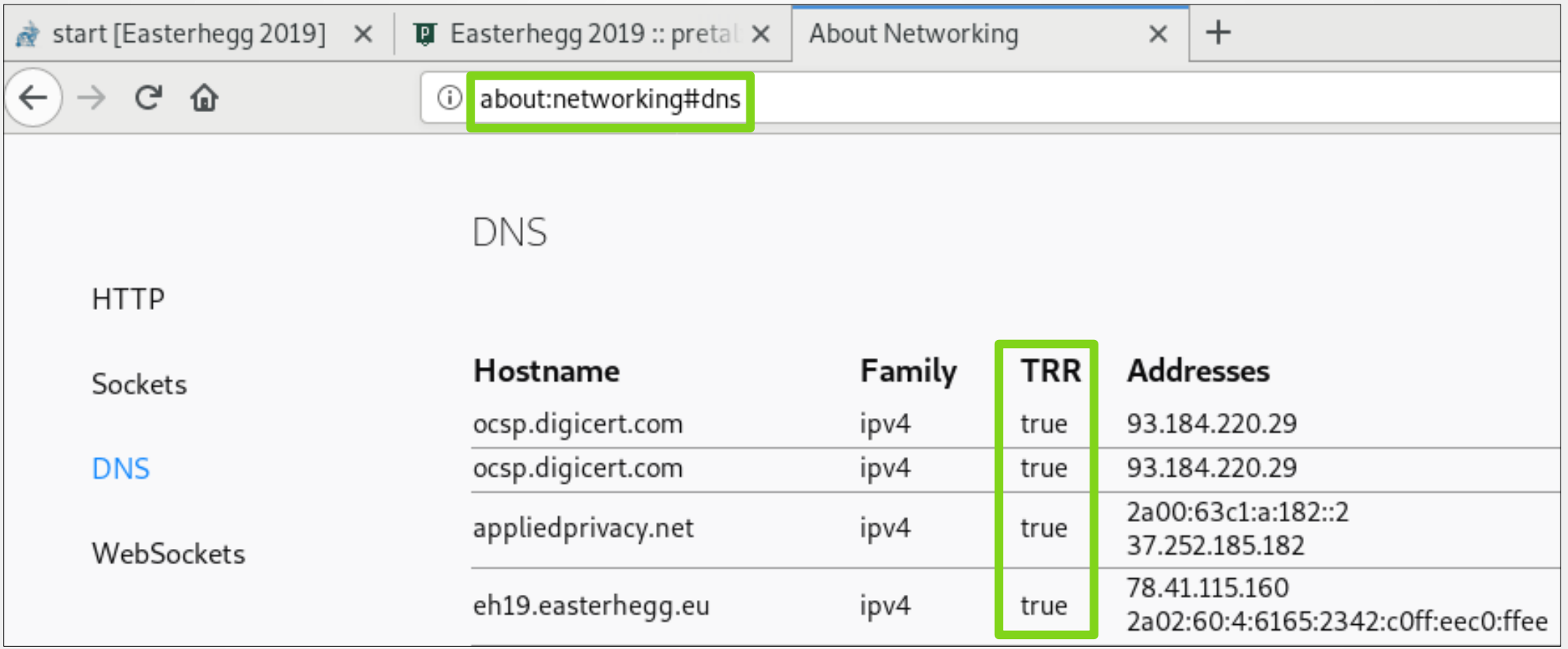
DoH in Firefox



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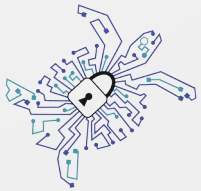
DoH -Firefox Modi

network.trr.mode:

2: “TRR first” - Fallback auf Klartext

3: “TRR only” - kein Fallback

https://daniel.haxx.se/blog/2018/06/03/inside-firefoxs-doh-engine/



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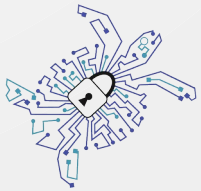
DoH Server Discovery in Chrome (angekündigt)

- Automatisches Upgrade zu DoH sofern unterstützt

- Statische Liste im Browser (Resolver IP -> DoH URI)



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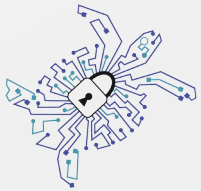
DoH Server Software

- Knot-Resolver 4.0.0
- Experimentell: doh-httpproxy, ...



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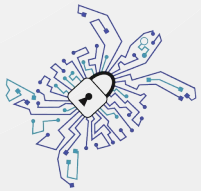
DoH Kritik: HTTP Metadaten



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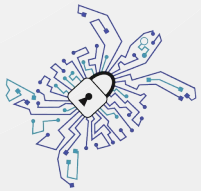
DoH Kritik: HTTP Metadaten

```
Header: :method: POST
Header: :path: /query
Header: :authority: doh.appliedprivacy.net
Header: :scheme: https
Header: user-agent: Mozilla/5.0 (X11; Fedora; Linux x86_64; rv:66.0) Gecko/20100101 Firefox/66.0
Header: accept: application/dns-message
Header: accept-language: en-US,en;q=0.5
Header: accept-encoding: gzip, deflate, br
Header: cache-control: no-store
Header: content-type: application/dns-message
Header: content-length: 54
Header: te: trailers
```



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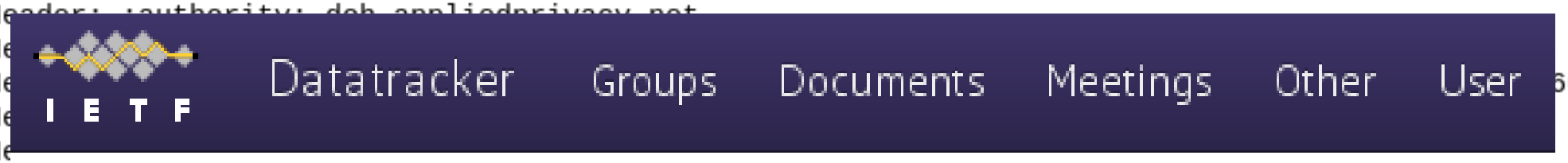
DoH Kritik: HTTP Metadaten

- Header: :method: POST
- Header: :path: /query
- Header: :authority: doh.appliedprivacy.net
- He
- He
- He
- He
- He
- He
- He
- He



66.0

DoHPE: DoH with Privacy Enhancements

draft-dickinson-doh-dohpe-00

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Mozilla / Cloudflare Kritik

Quelle: https://ungleich.ch

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Mozilla / Cloudflare Kritik

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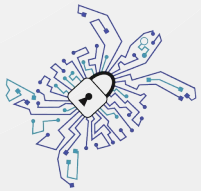
Mozilla / Cloudflare Kritik

https://dnscrypt.info/public-servers/

https://github.com/curl/curl/wiki/DNS-over-HTTPS



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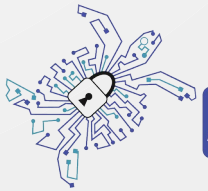
DoH / ISP Kritik



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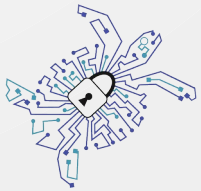
DoH / ISP Kritik

DOH
Internet-Draft
Intended status: Informational
Expires: September 9, 2019

M. Antonakakis
Georgia Institute of Technology
J. Livingood
Comcast
B. Sleigh
BT Plc
A. Winfield
Sky
March 8, 2019

Centralized DNS over HTTPS (DoH) Implementation Issues and Risks
draft-livingood-doh-implementation-risks-issues-00



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DoH
Internet-Draft
Intended status: Informational
Expires: September 11, 2019

A. Fidler
BT plc
B. Hubert
OpenXchange
J. Livingood
Comcast
J. Reid
RTFM llp
N. Leymann
Deutsche Telekom AG
March 10, 2019

DNS over HTTPS (DoH) Considerations for Operator Networks
draft-reid-doh-operator-00

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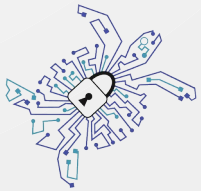
DoH / ISP Kritik

> This will have two unwelcome results. First, threat intelligence and reputation services will have fewer data to analyse and therefore have a significantly less complete perspective of end users' DNS behaviour. Second, the quality and effectiveness of the data provided by threat intelligence and reputation services will be



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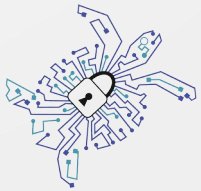
DoT vs. DoH

	DoT	DoH
Zensurresistenter	-	+
mit ESNI in Firefox kompatibel	-	+
wenig Metadaten für den Resolver	+	-
Server Software Verfügbarkeit	+	~
Easy Setup (Client)	~	+



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wenig Metadaten für den Resolver	+	-
Server Software Verfügbarkeit	+	~
Easy Setup (Client)	~	+

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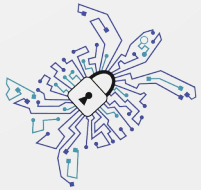
DoH / DoT – DNSSEC?

- Löst unterschiedliche Problem

- Am besten in Kombination eingesetzt



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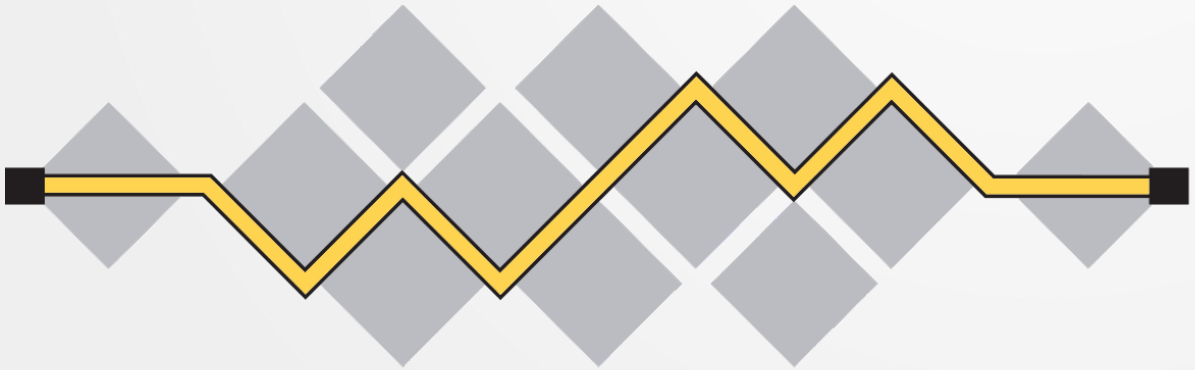
DNS Privacy - Zukunft

- DoH/DoT Server Discovery Protokolle
- Verschlüsselung zu authoritative Server
- DNS over QUIC



I E T F®

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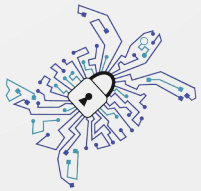
Fazit

- Verschlüsselt euren DNS Traffik!
- Auch mit DoH/DoT sind Metadaten (zB Hostname) sichtbar (ESNI erforderlich!)
- DoH: pot. schnelle Verbreitung durch Firefox



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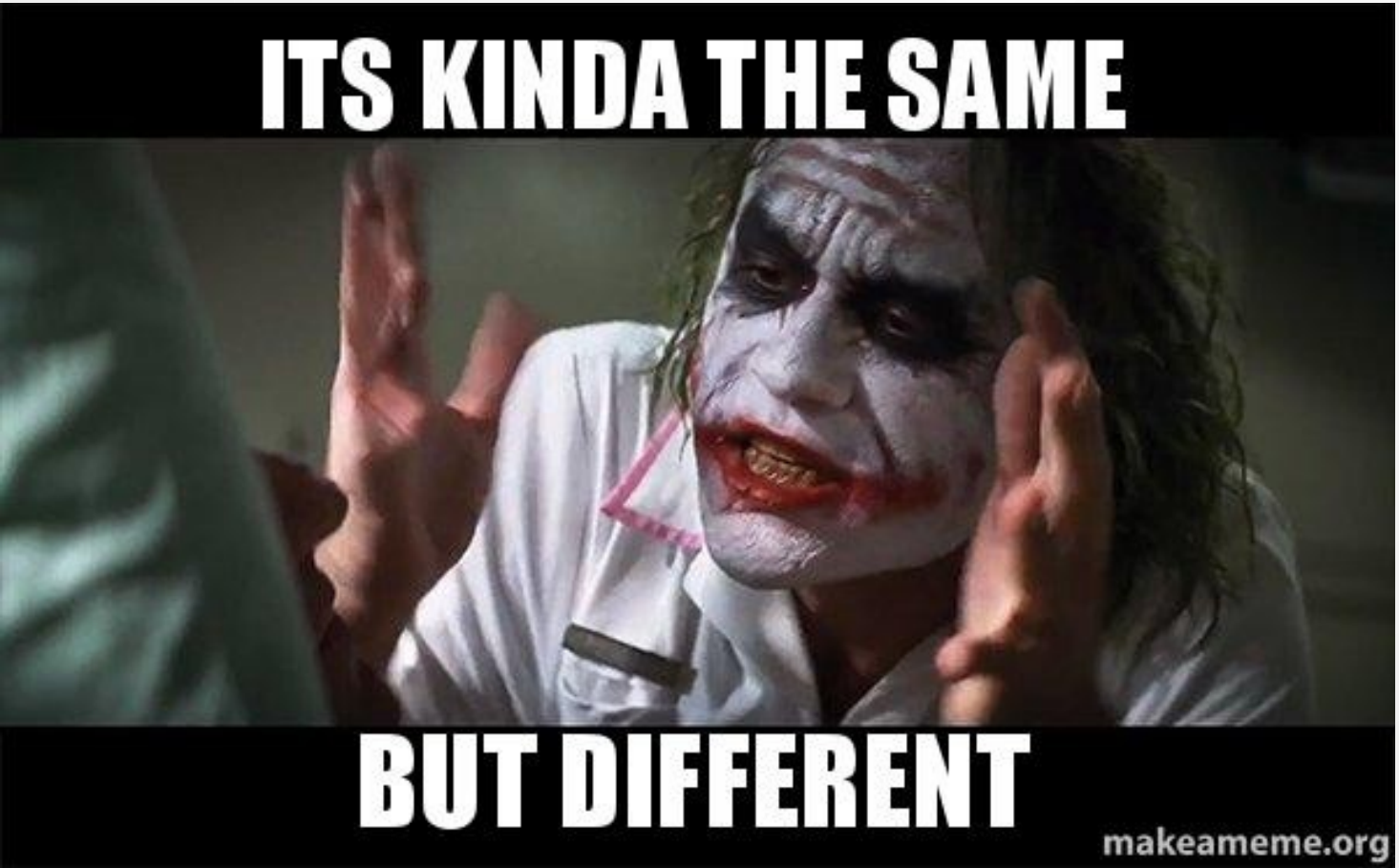
Fazit

DoT und DoH haben die selben Kernziele



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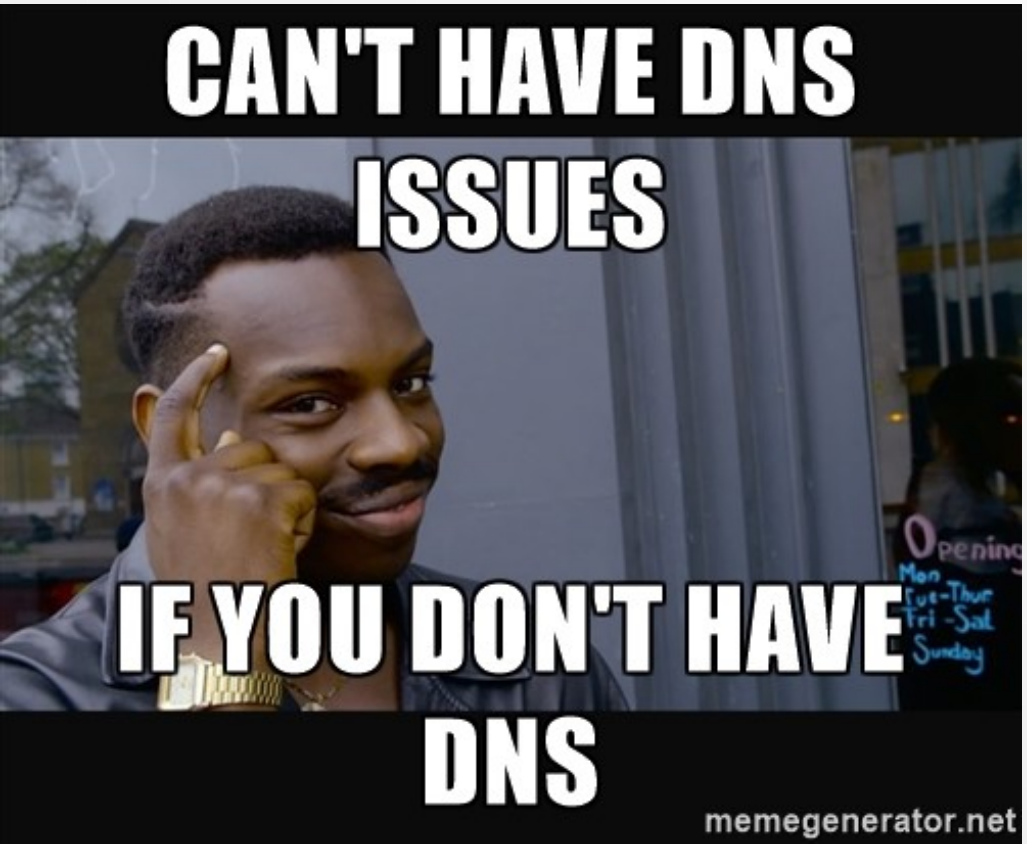
Fazit

Verwende (weiterhin) **Torbrowser** für die stärksten Privacyeigenschaften



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Unsere DNS Privacy Resolver

https://doh.appliedprivacy.net/query

dot1.appliedprivacy.net
dot2.appliedprivacy.net

Kein Logging der IP Adresse / Query

QNAME Minimzation, DNSSEC

gdbr6pm66tzpavenstxove4ftwil52onqmhwioyb7dffojc6h56saoqd.onion

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Fragen?

contact@appliedprivacy.net

@applied_privacy
https://mastodon.social/@applied_privacy

https://appliedprivacy.net

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