Circumvention of tracking protections by means of first-party tracking

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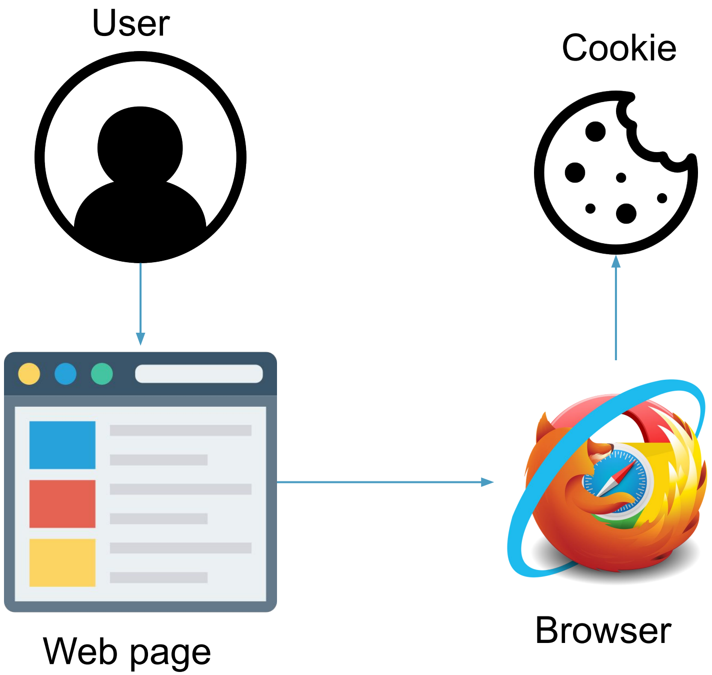
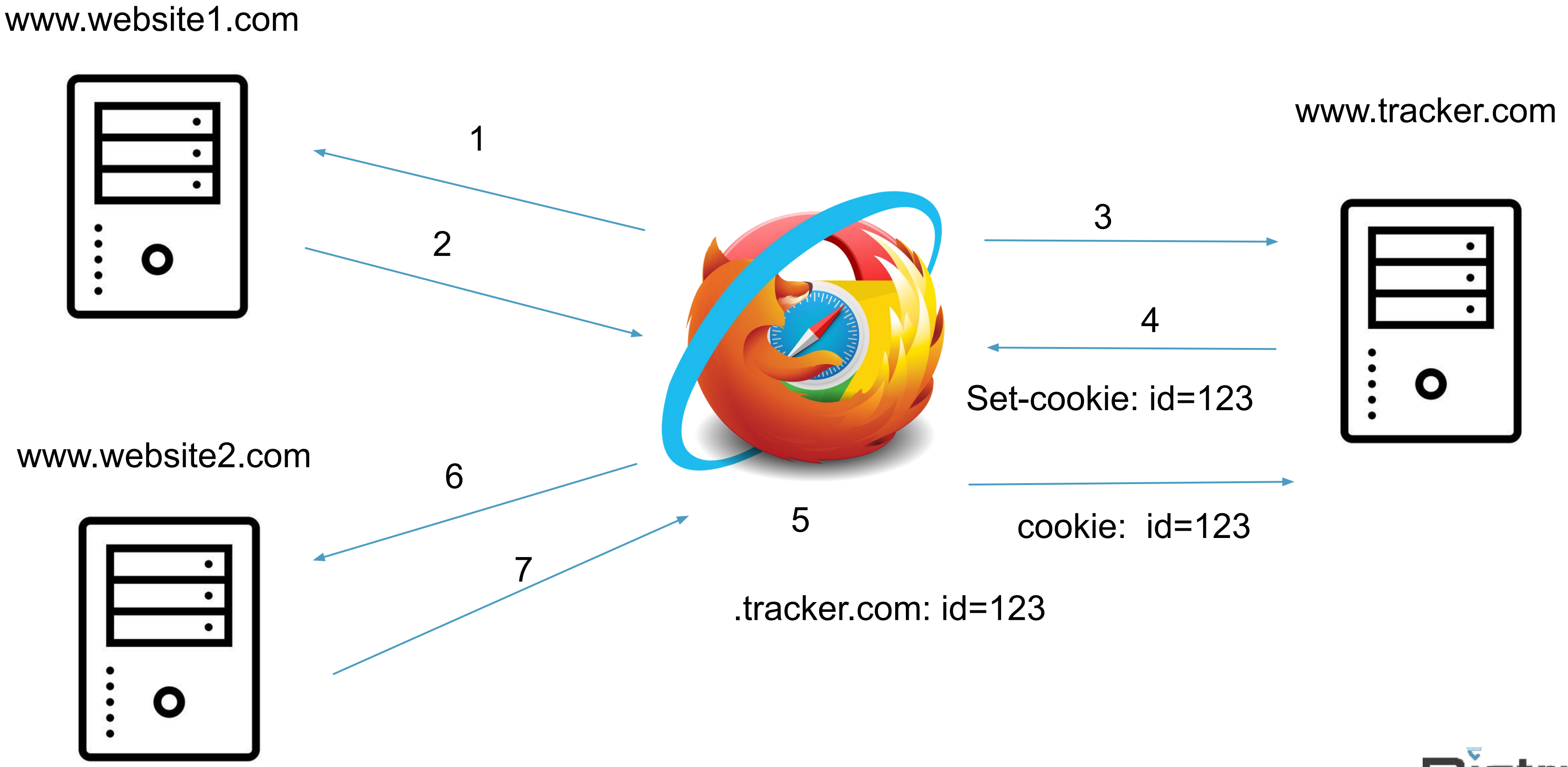
DistriNet

Online tracking



- Session cookies
  - Essential
  - First-party
  - Provide functionality
- Tracking cookies
  - Unique identifier
  - Can be first-party of third-party
- Same-origin policy
  - Security measure
  - Prevent resource access

Third-party tracking



www.website1.com

www.tracker.com

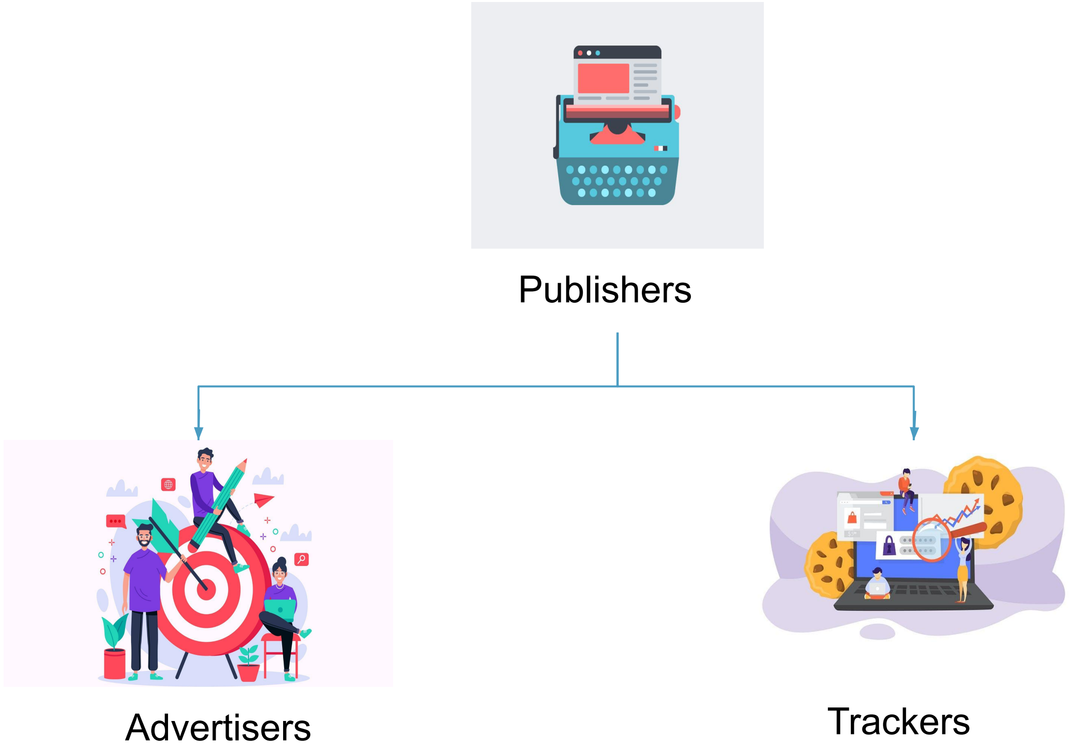
www.website2.com

Set-cookie: id=123

cookie: id=123

.tracker.com: id=123

Key Players

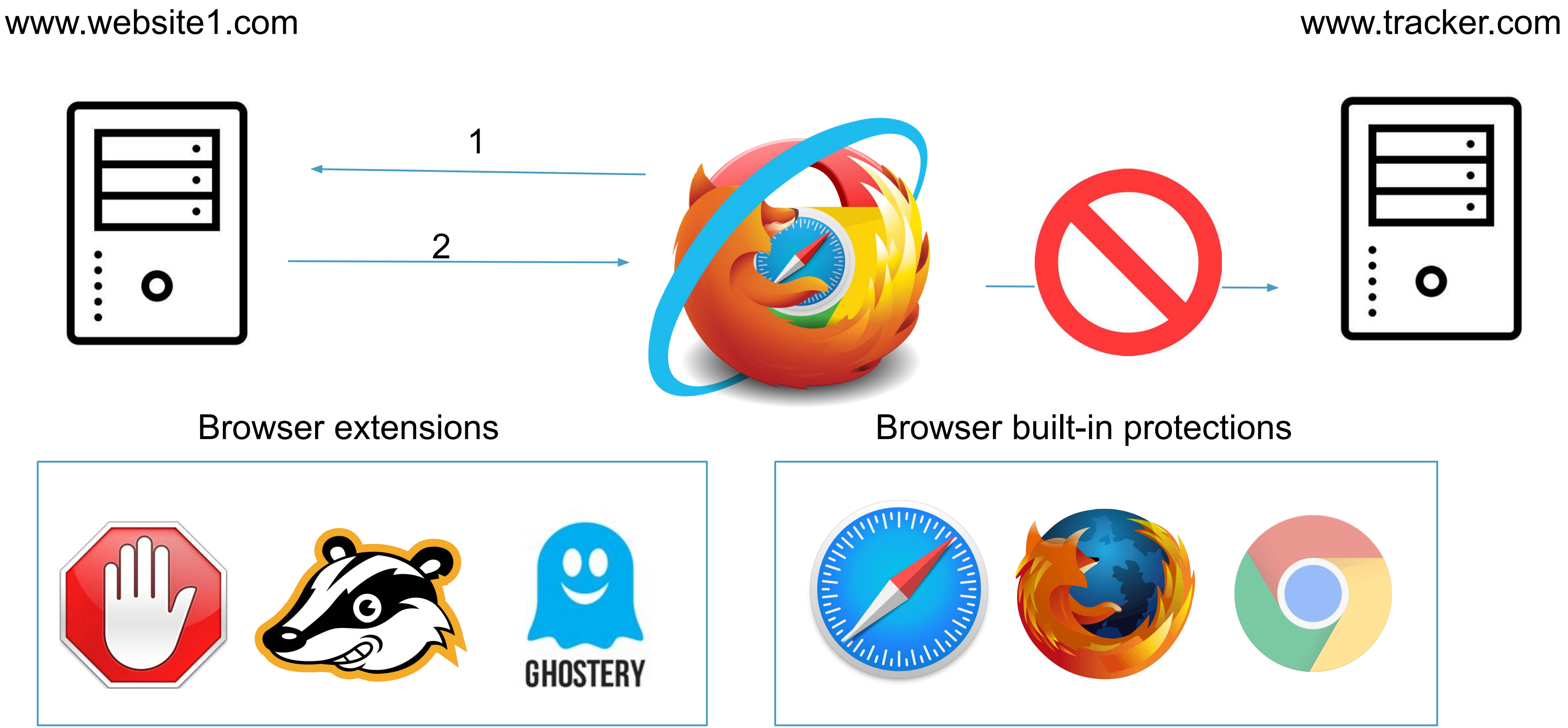


Publishers

Advertisers

Trackers

Third-party tracking



Browser extensions

Browser built-in protections

Key Players

Publishers

Trackers

Advertisers

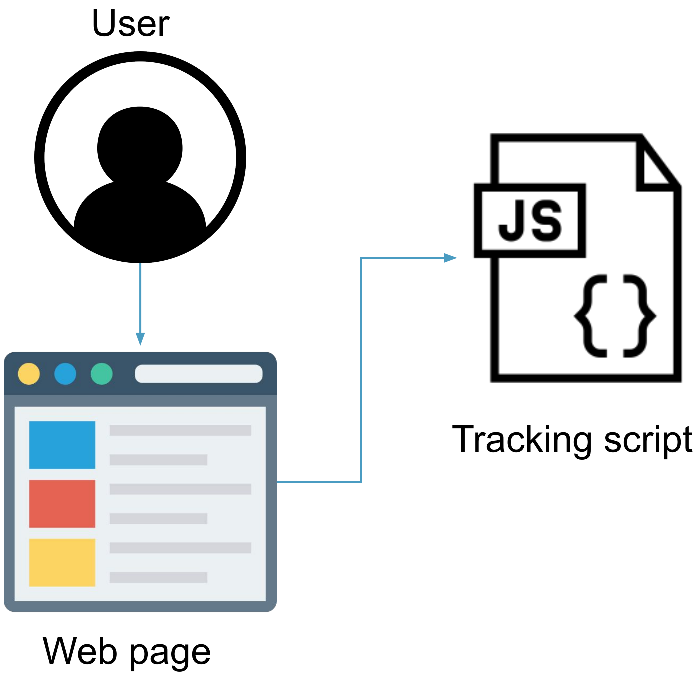
vs.

Users

Browsers

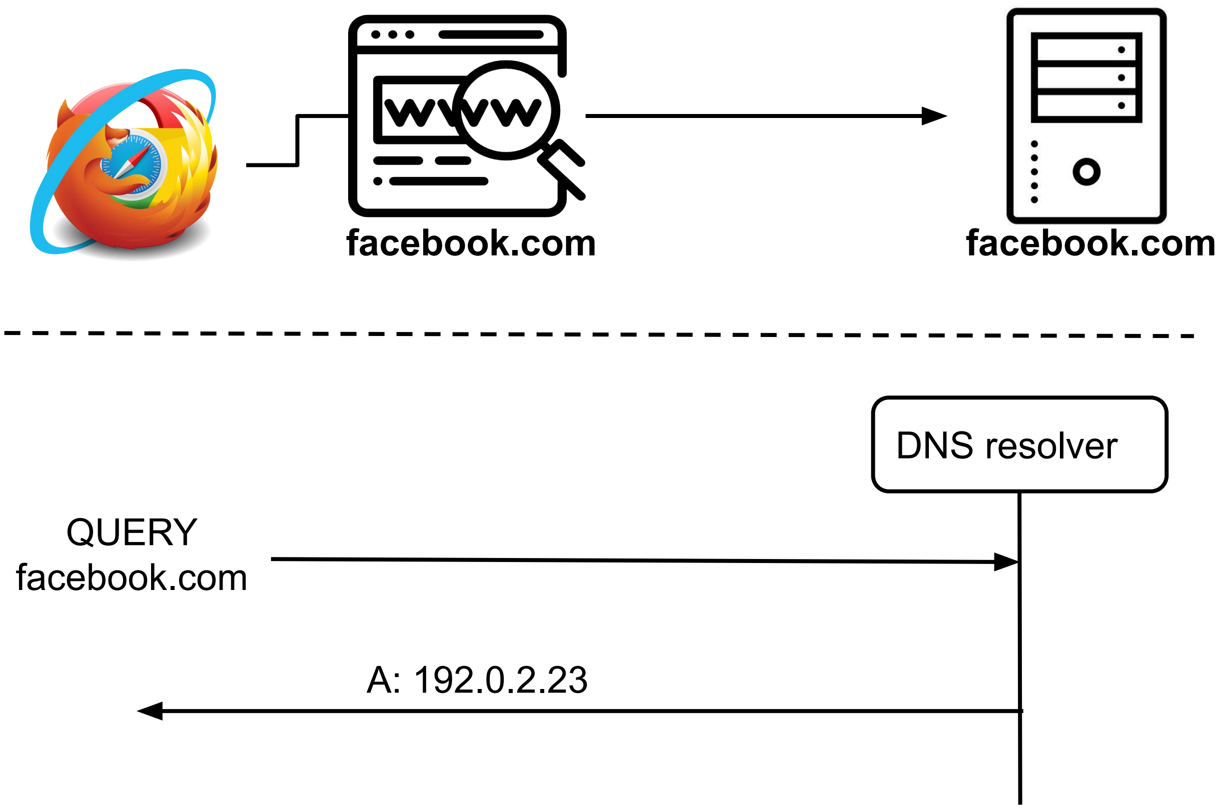
Privacy protections

First-party tracking



- As a circumvention of cookie blocking
- First-party cookie
- Same-site
  - Insights on user behavior
- In combination with persistent tracking

DNS



facebook.com

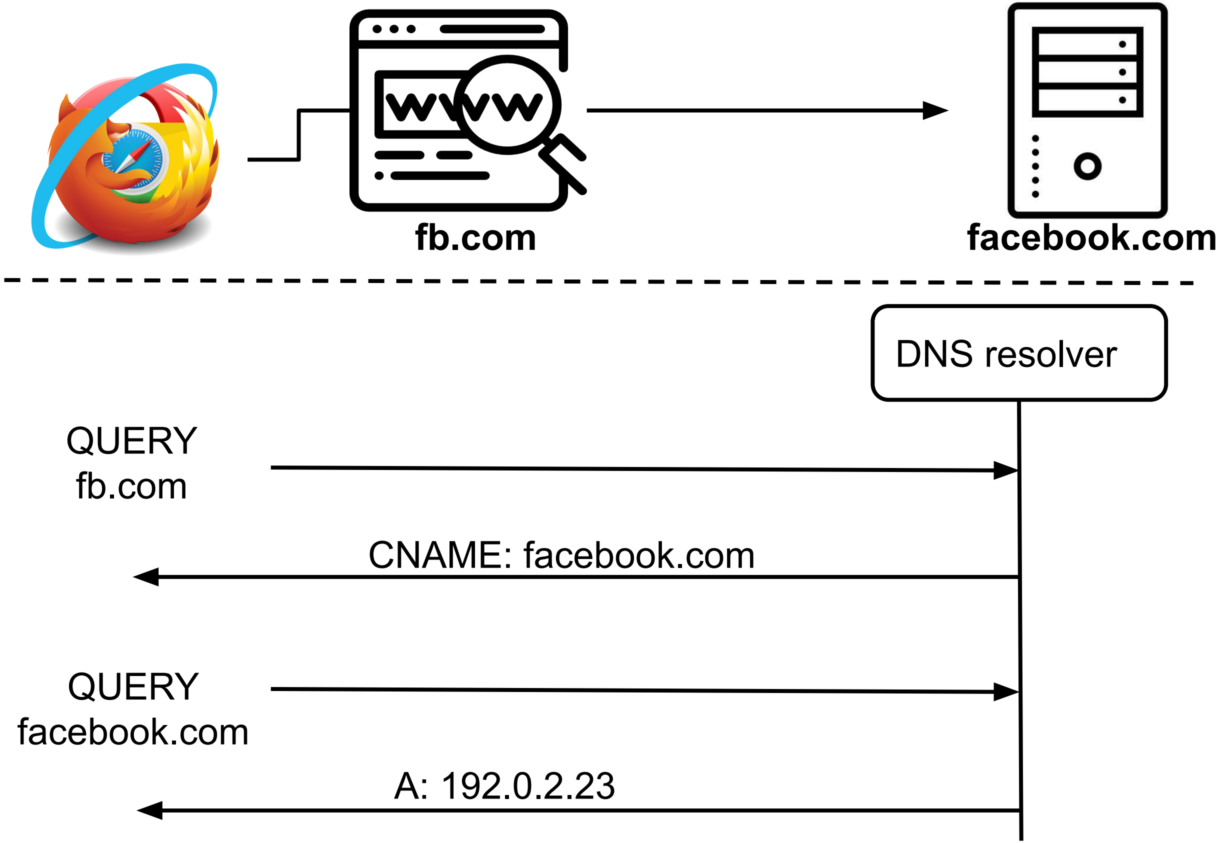
facebook.com

DNS resolver

QUERY
facebook.com

A: 192.0.2.23

DNS



fb.com

facebook.com

DNS resolver

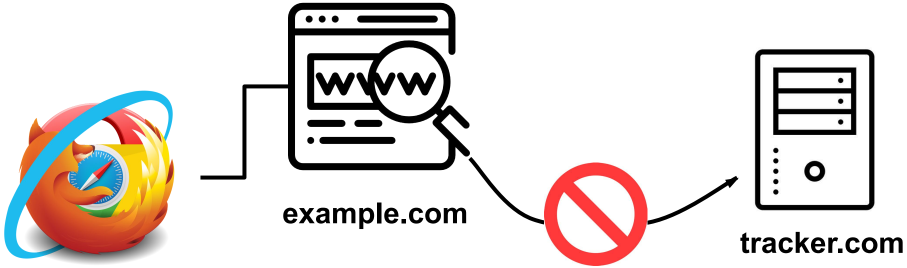
QUERY
fb.com

CNAME: facebook.com

QUERY
facebook.com

A: 192.0.2.23

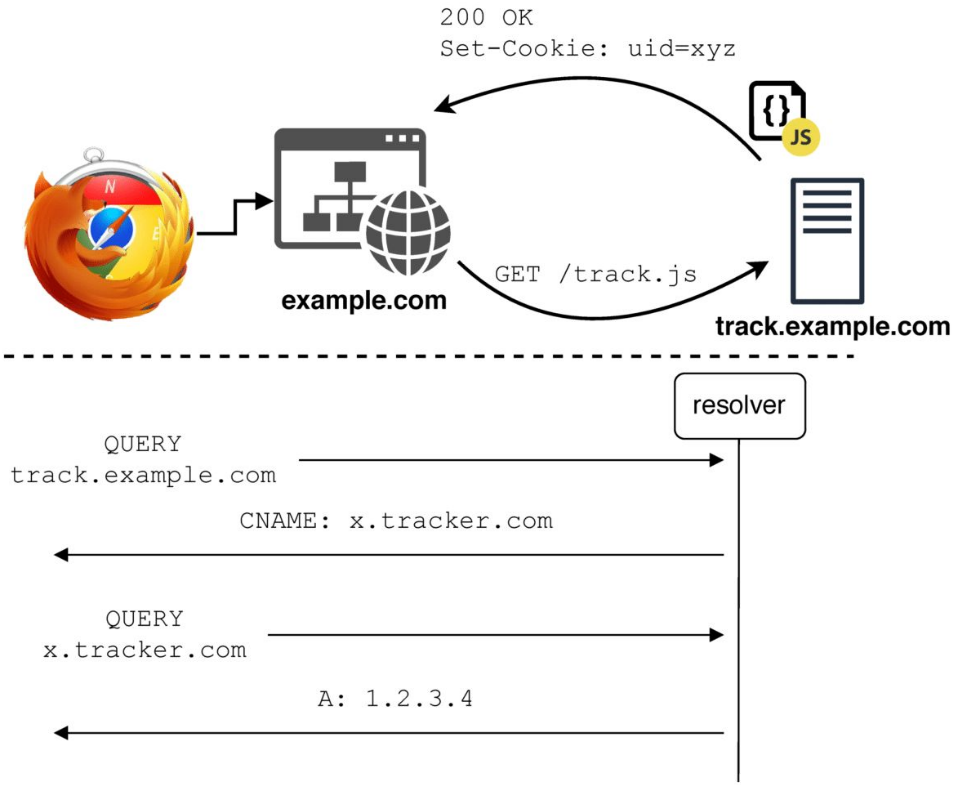
Third-party tracking



example.com

tracker.com

CNAME-based tracking



```
200 OK
Set-Cookie: uid=xyz
```

example.com

```
GET /track.js
```

track.example.com

resolver

```
QUERY
track.example.com
```

```
CNAME: x.tracker.com
```

```
QUERY
x.tracker.com
```

```
A: 1.2.3.4
```

Detecting CNAME-based tracking

Methodology

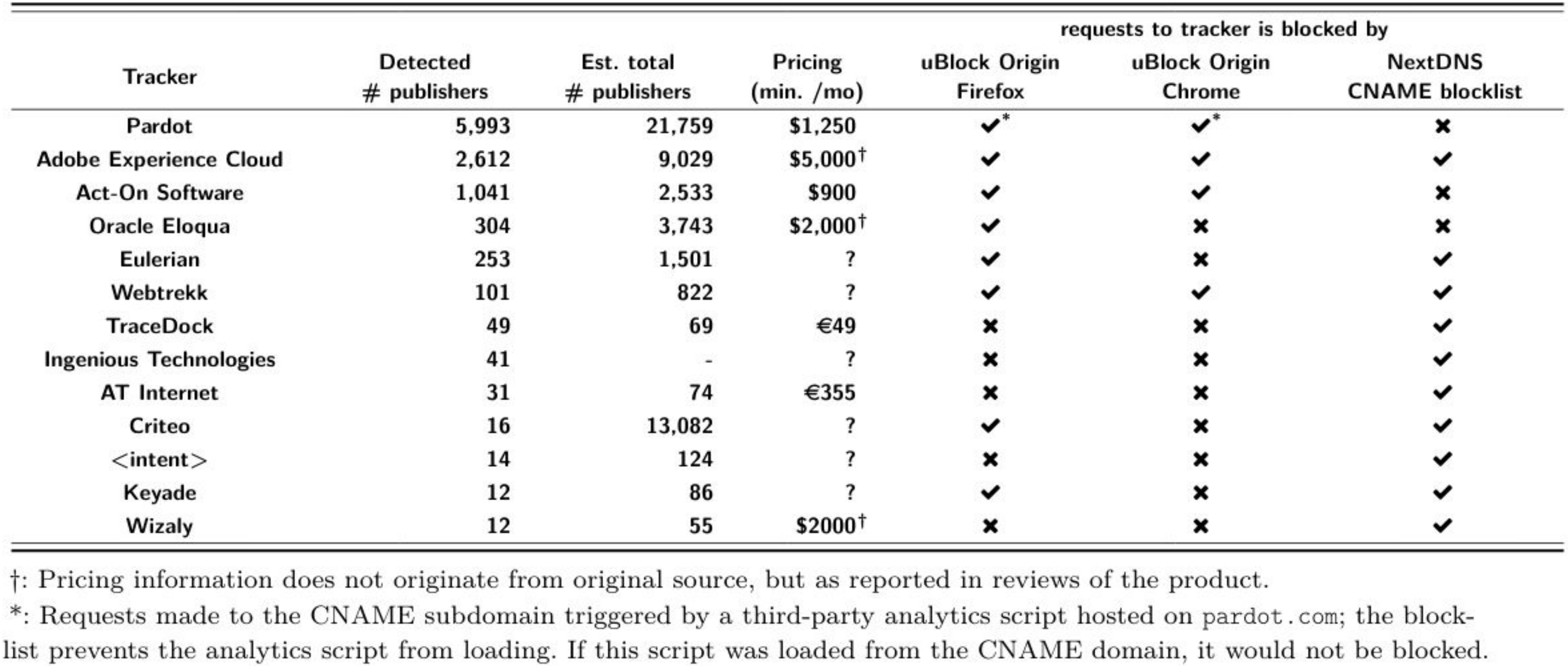
- Step 1: CNAME records
  - First party points to third party
- Step 2: Dataset
  - Starting from HTTP Archive (5.6M frequently-visited websites) dataset
  - First-party requests to subdomain

List of CNAME tracker candidates

Methodology

- Step 3: Filter non-tracking candidates
    - Manual analysis
    - Analyse candidate website for references to tracking or features that would require tracking
    - 13 manually-verified trackers
    - Tracker-specific fingerprint
- Step 4: Validation
    - Run crawl with other user agent (Safari)
    - Found tracker that only did tracking for Safari users

Results

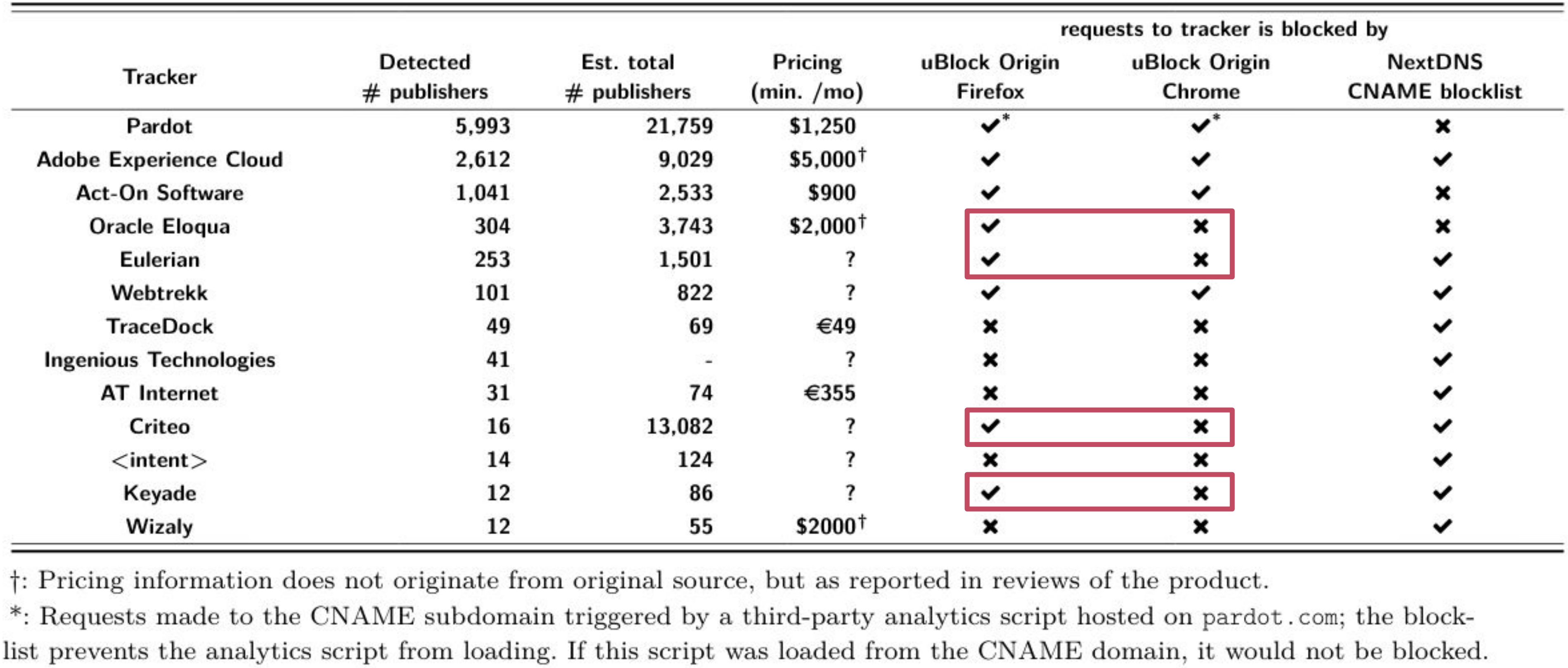


Tracker	Detected # publishers	Est. total # publishers	Pricing (min. /mo)	requests to tracker is blocked by uBlock Origin Firefox	 uBlock Origin Chrome	 NextDNS CNAME blocklist
Pardot	5,993	21,759	$1,250	✓*	✓*	✗
Adobe Experience Cloud	2,612	9,029	$5,000†	✓	✓	✓
Act-On Software	1,041	2,533	$900	✓	✓	✗
Oracle Eloqua	304	3,743	$2,000†	✓	✗	✗
Eulerian	253	1,501	?	✓	✗	✓
Webtrekk	101	822	?	✓	✓	✓
TraceDock	49	69	€49	✗	✗	✓
Ingenious Technologies	41	-	?	✗	✗	✓
AT Internet	31	74	€355	✗	✗	✓
Criteo	16	13,082	?	✓	✗	✓
<intent>	14	124	?	✗	✗	✓
Keyade	12	86	?	✓	✗	✓
Wizaly	12	55	$2000†	✗	✗	✓

†: Pricing information does not originate from original source, but as reported in reviews of the product.

*: Requests made to the CNAME subdomain triggered by a third-party analytics script hosted on `pardot.com`; the blocklist prevents the analytics script from loading. If this script was loaded from the CNAME domain, it would not be blocked.

Results



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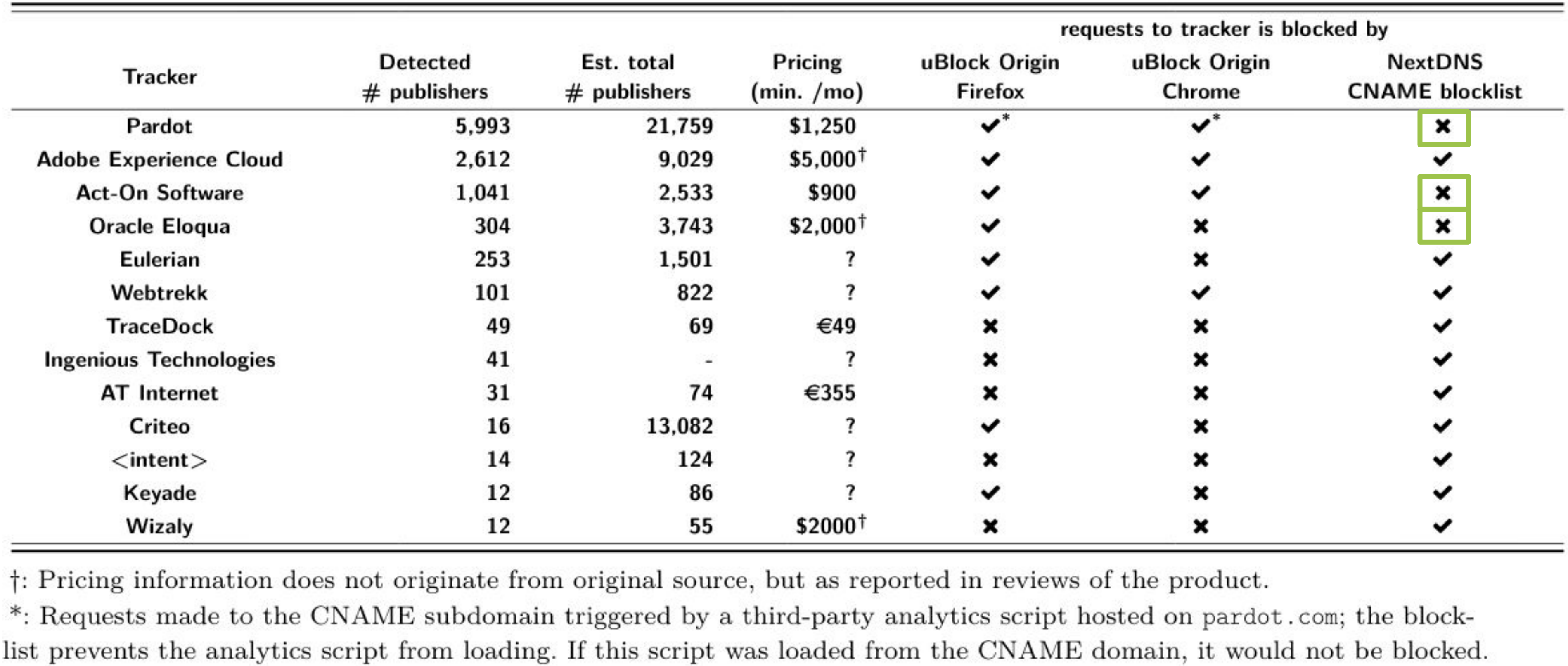

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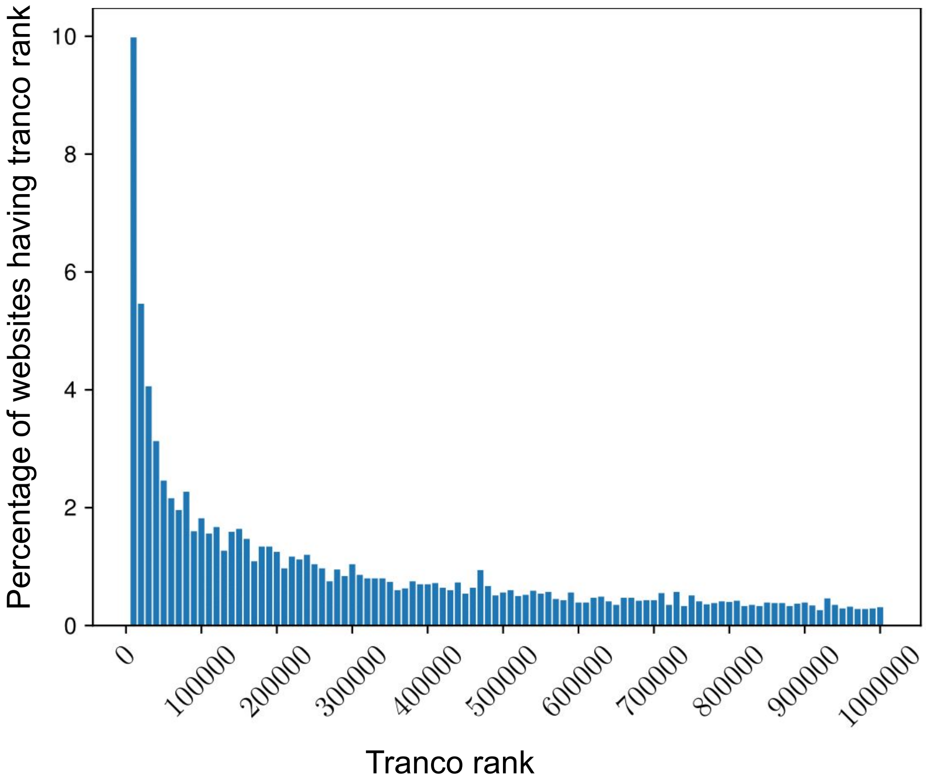
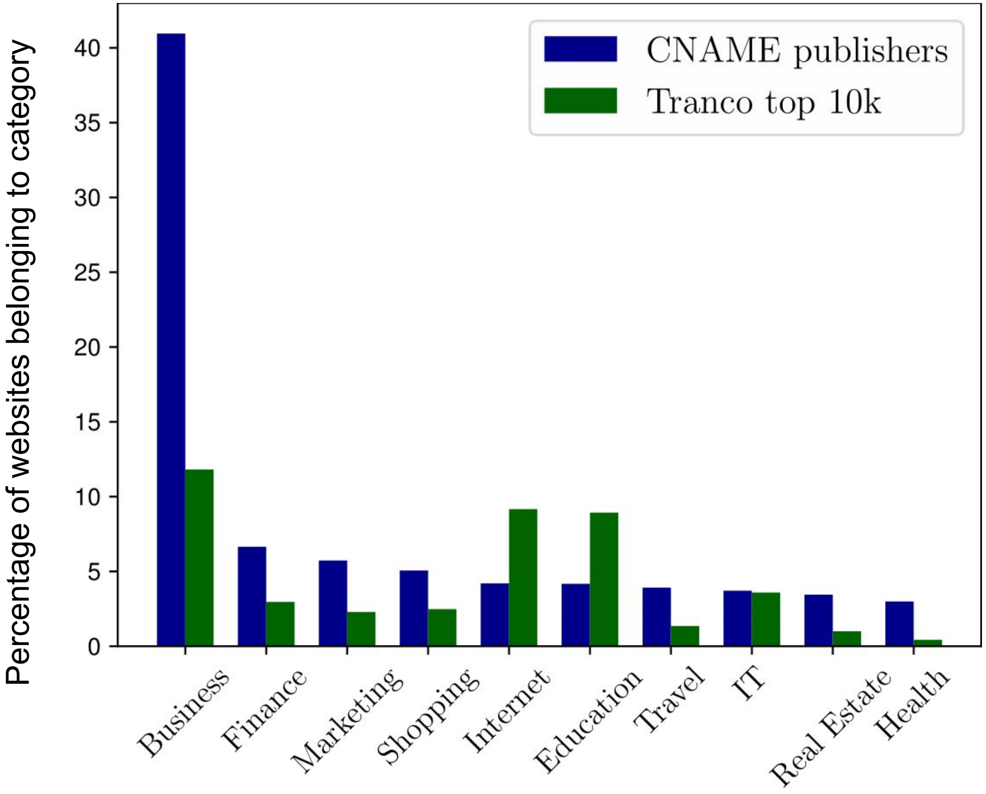
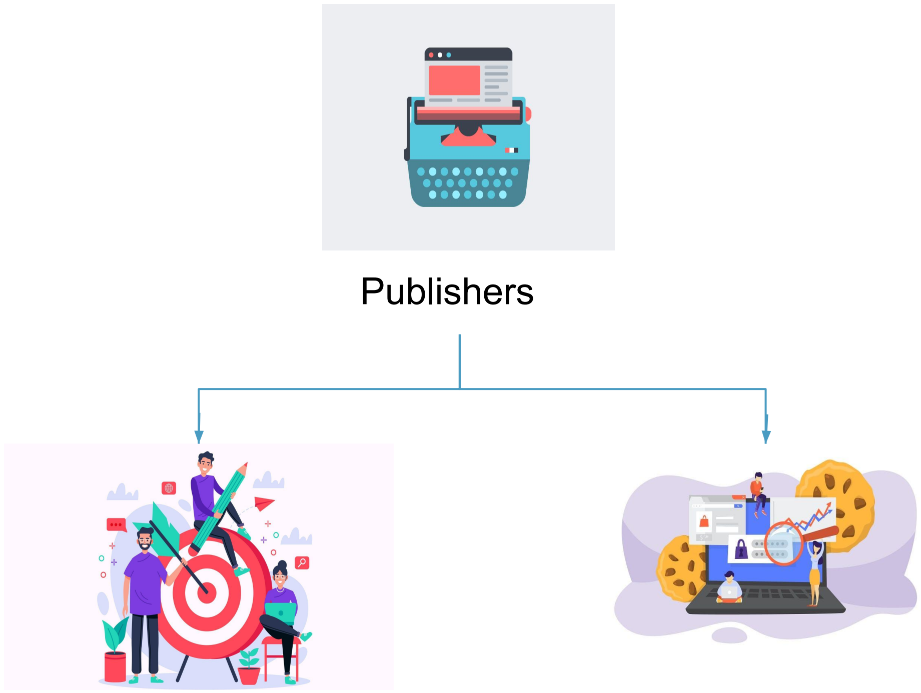
Popularity of publishers using CNAME-based tracking



Categories of publishers using CNAME-based tracking



Key Players



Publishers

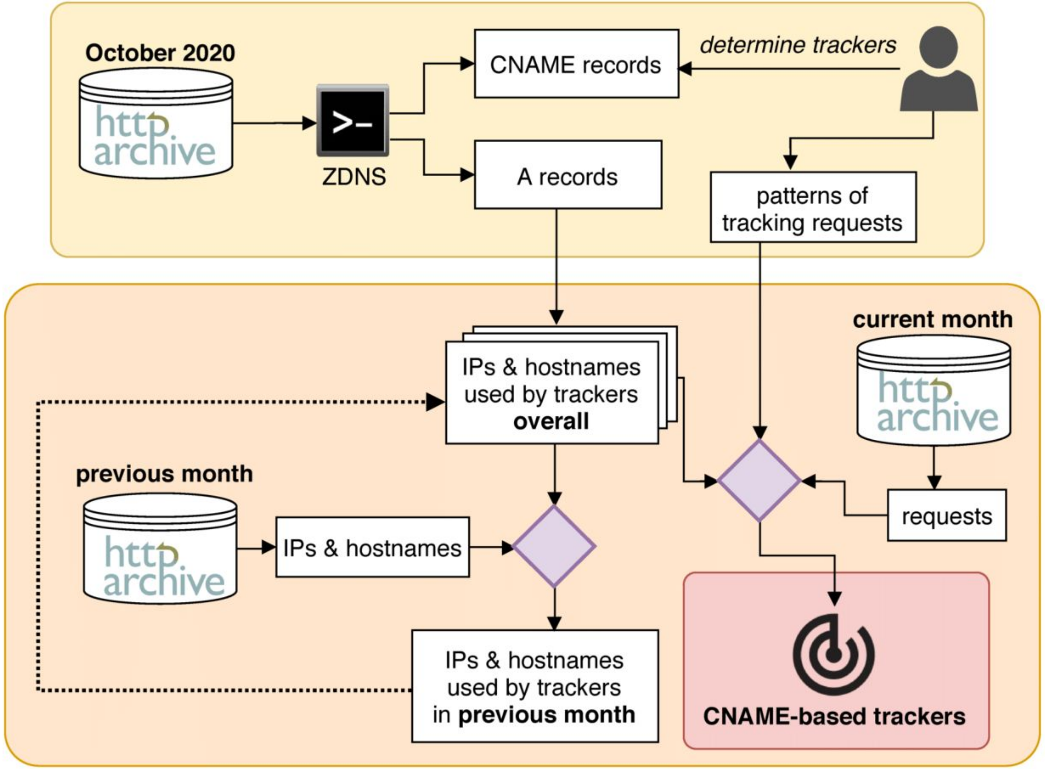
Advertisers

Trackers

- 10 474 publishers
  - Mostly businesses
  - 9.98% in Tranco top 10k
- 13 CNAME-based trackers
  - Varying size
  - Previously unknown

Historical evolution of CNAME-based tracking

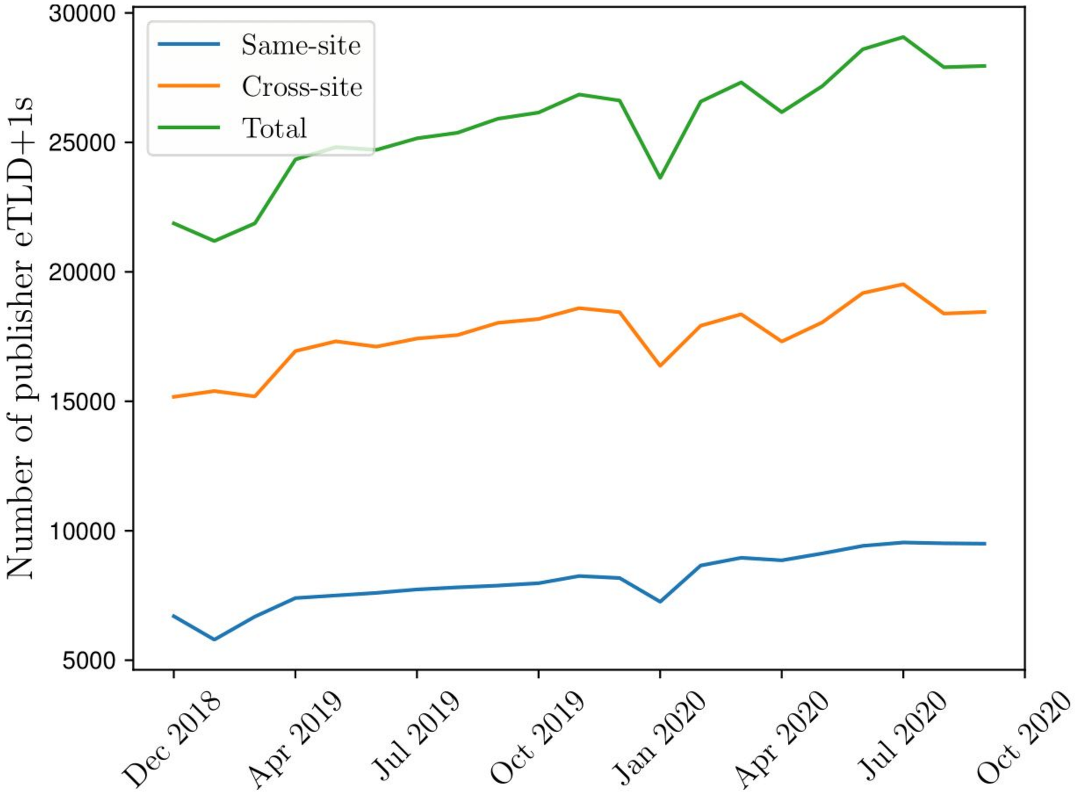
Methodology



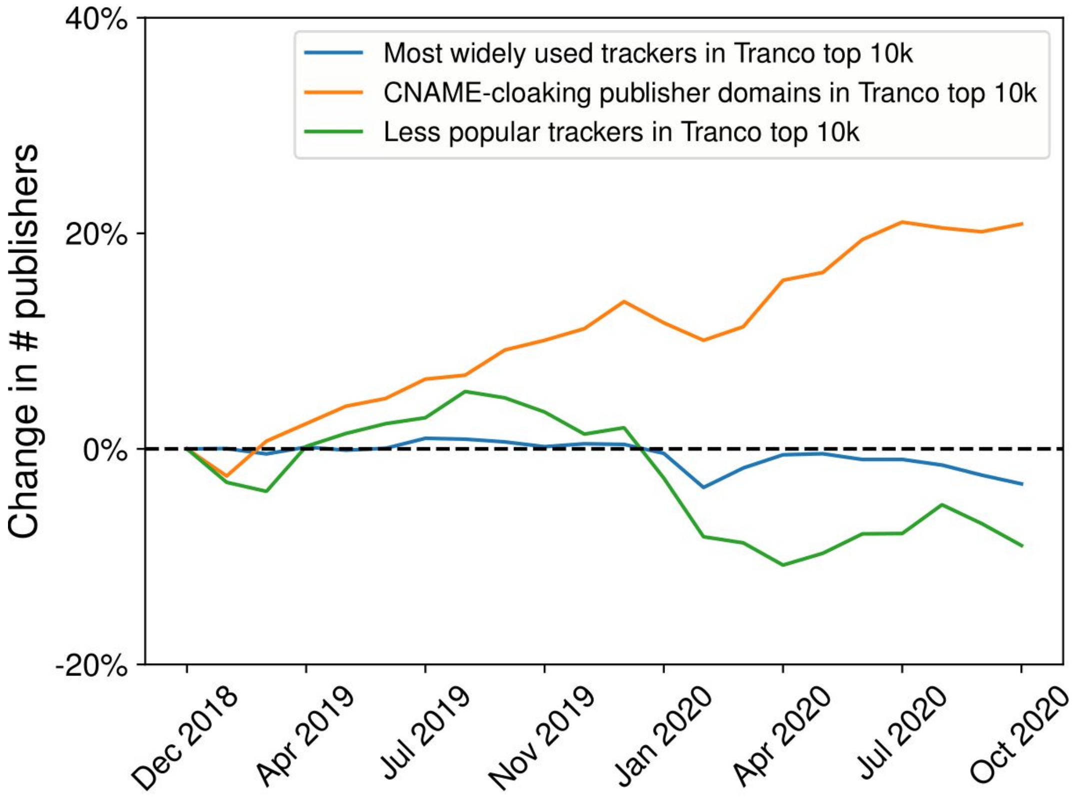
› Public dataset
  - HTTP Archive

› Recursive approach

Historical Analysis



Comparison to third-party tracking



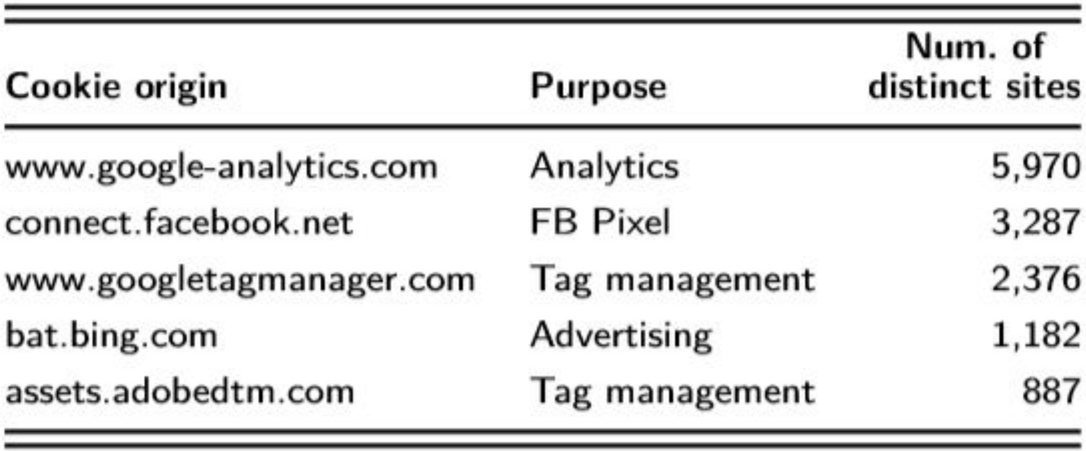
Effects on third-party tracking

- Evolution of third-party tracking
- Recent CNAME publisher websites
  - 6 months non-active/6 consecutive months active
  - Number of third-parties unchanged
  - Complimentary basis

Implications of CNAME-based tracking

Privacy

- Cookie leaks
  - Cookies scoped to domain of website
  - 8807 sites using CNAME-based tracking
  - Cookies leaking on 95% sites



Cookie origin	Purpose	Num. of distinct sites
www.google-analytics.com	Analytics	5,970
connect.facebook.net	FB Pixel	3,287
www.googletagmanager.com	Tag management	2,376
bat.bing.com	Advertising	1,182
assets.adobedtm.com	Tag management	887

Privacy

- Cookies leaking in request URLs
  - Cookie syncing
  - Bypass tracking protections
  - Set by third-party domain of the tracker

Privacy

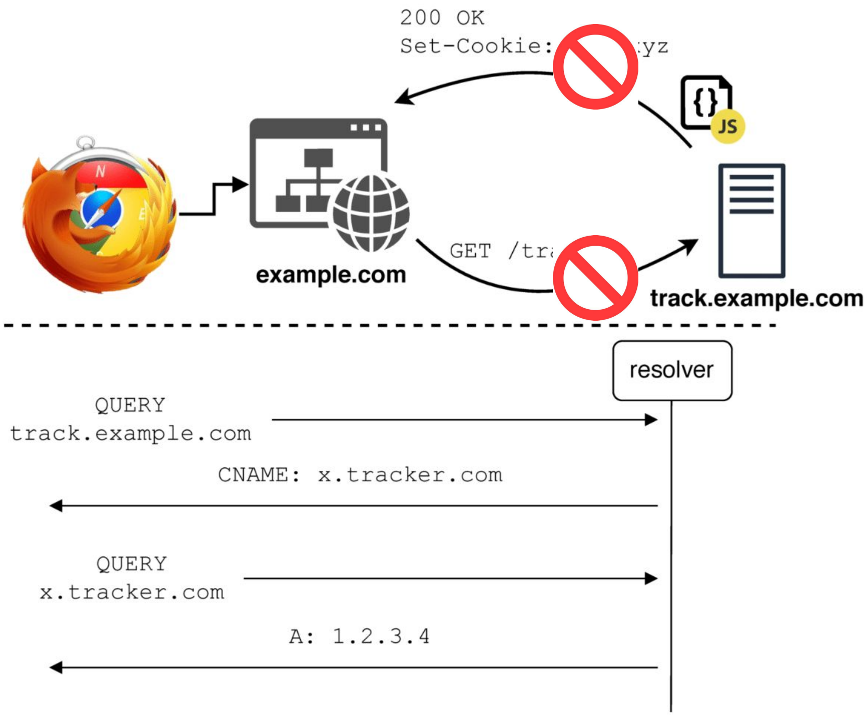
- Leaking of sensitive information from cookies
- Manual analysis on 50 websites
  - Full name (1 website)
  - Location (2 websites)
  - Email (4 websites)
  - Authentication cookie (10 websites)

Security

- Issues arising from the CNAME-based tracking scheme
- Tracker included in first-party context
- Two major vulnerabilities affecting all publisher websites

Countermeasures

- DNS-level blocking
- Limited cookie lifetime



Conclusion

- Methodology allows to detect previously unknown CNAME-based trackers
- Large-scale evaluation of CNAME-based tracking
  - Increased in popularity by 21%
- Privacy and security issues
  - Two major web security flaws
  - Sensitive information leaking

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Thank you!

https://distrinet.cs.kuleuven.be/