Insights from a 1-million-site Measurement of Online Tracking

and how our data can help your research!

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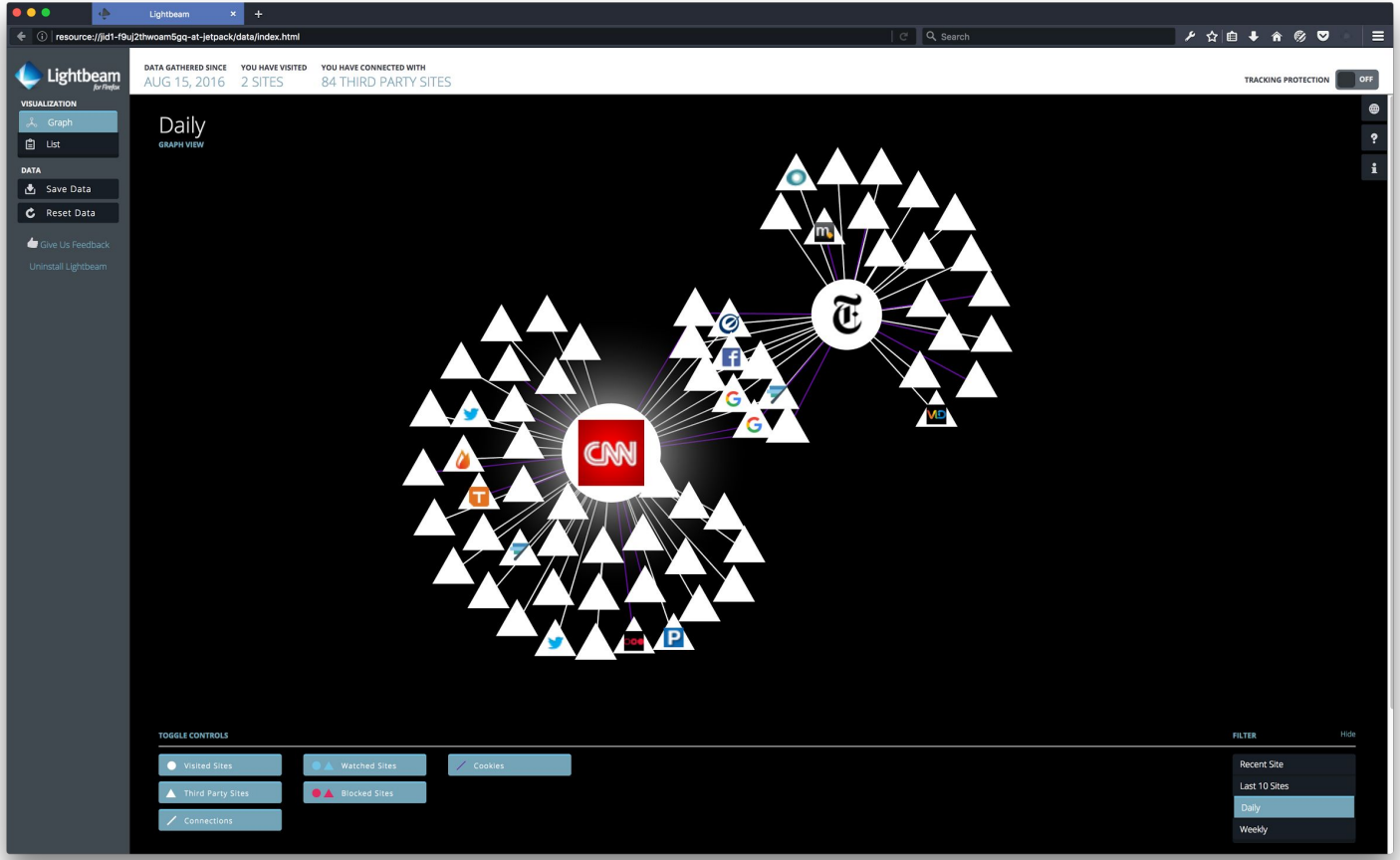
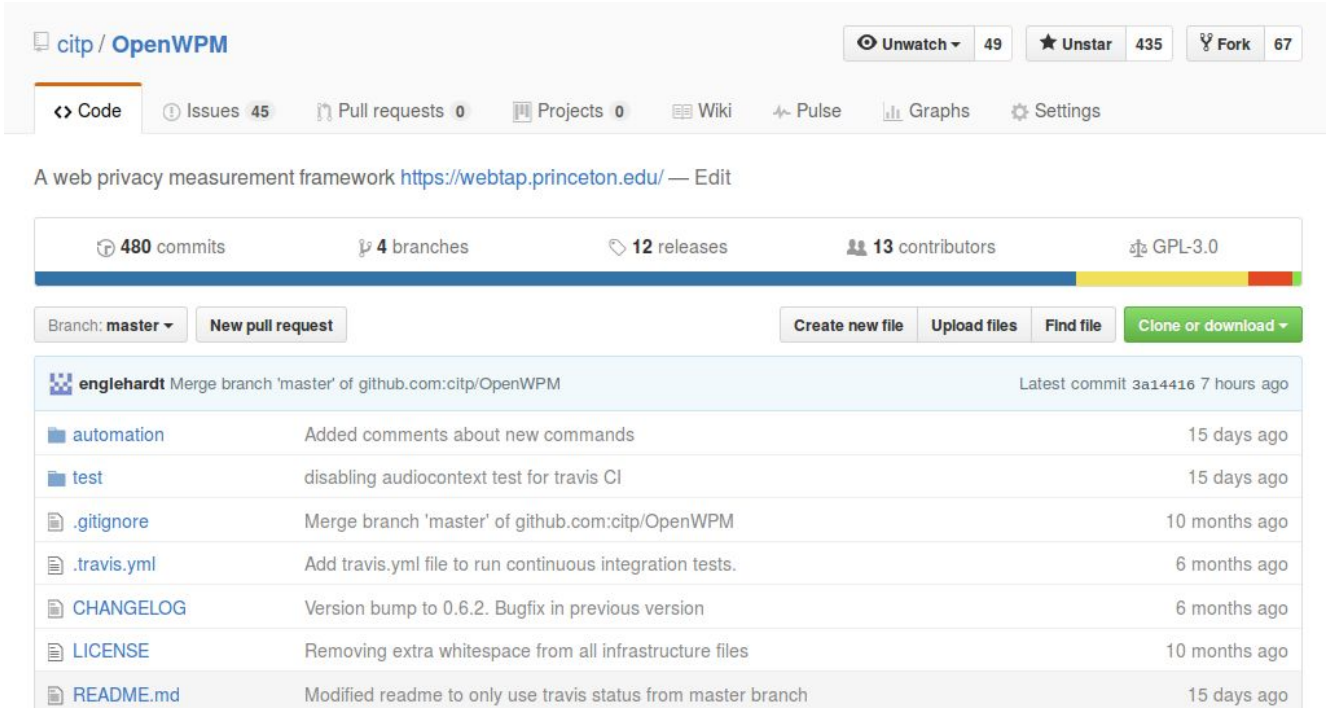
Visiting 2 websites results in 84 third parties contacted



Open Web Privacy Measurement (OpenWPM)



https://github.com/citp/OpenWPM

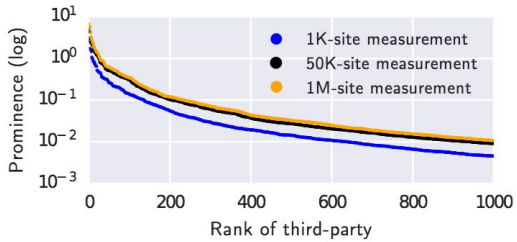
The Princeton Web Census

Monthly
1 Million Site Crawl

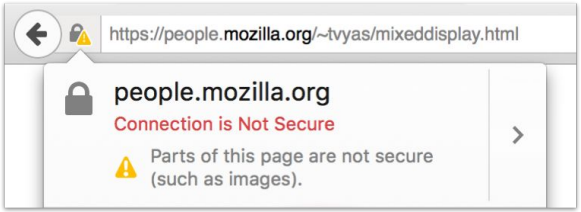
Collecting:

- Javascript Calls
- All javascript files
- HTTP Requests and Responses
- Storage (cookies, Flash, etc)

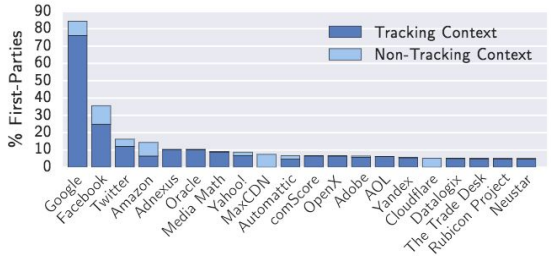
Insights from the Princeton Web Census



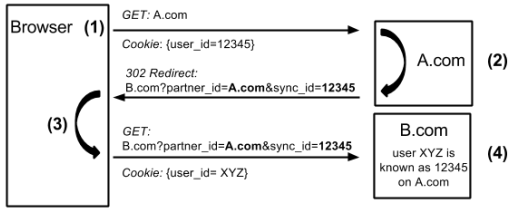
New metric to rank third parties



Trackers impede HTTPS adoption



Consolidation of third-parties



45 out of top 50 3rd parties cookie sync

Online Tracking: A 1-million-site Measurement and Analysis (CCS 2016)

Impact of OpenWPM and the Princeton Web Census

Open-sourcing early can help spur adoption

Study using OpenWPM	Conference	Year
The Web Never Forgets: Persistent Tracking Mechanisms in the Wild	**CCS**	**2014**
Cognitive disconnect:Understanding Facebook Connect login permissions	OSN	2014
Cookies that give you away: The surveillance implications of web tracking	**WWW**	**2015**
Upgrading HTTPS in midair: HSTS and key pinning in practice	NDSS	2015
Web Privacy Census	Tech Science	2015
Variations in Tracking in Relation to Geographic Location	W2SP	2015
No Honor Among Thieves: A Large-Scale Analysis of Malicious Web Shells	WWW	2016
Online Tracking: A 1-million-site Measurement and Analysis	**CCS**	**2016**
Dial One for Scam: Analyzing and Detecting Technical Support Scams	NDSS	2017

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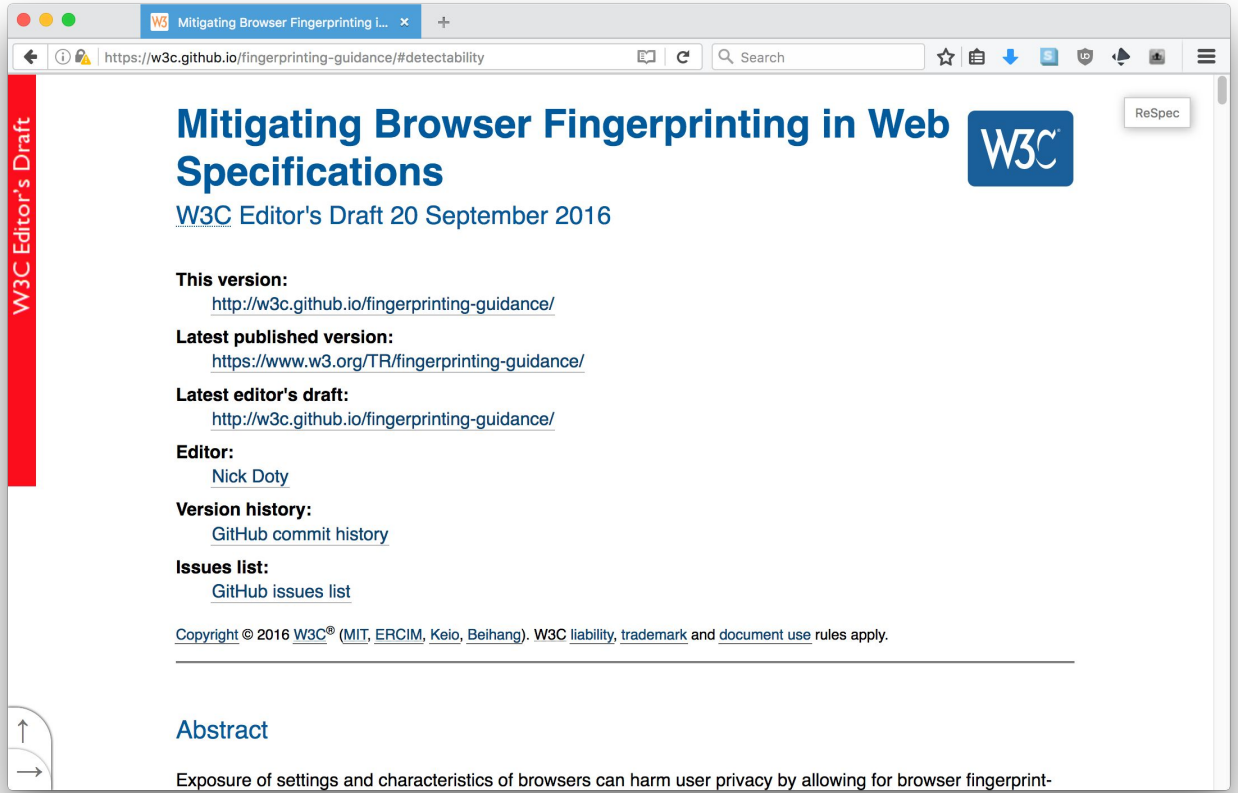
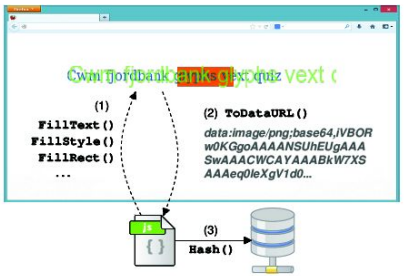
Measurement work can influence standards



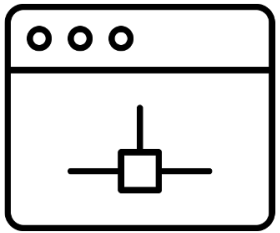
https://w3c.github.io/fingerprinting-guidance

How can measurement influence adoption of new tracking techniques?

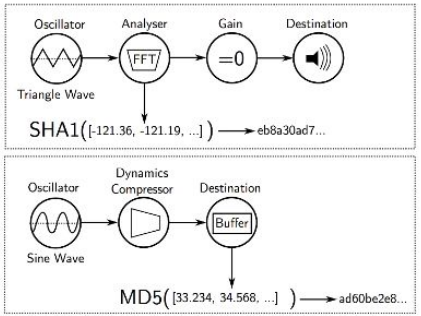
Canvas



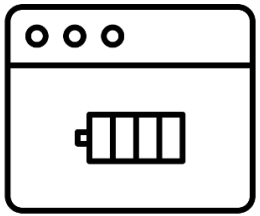
WebRTC



Audio



Battery



https://webtransparency.cs.princeton.edu/webcensus/

Canvas fingerprinting returns in the absence of measurement

May 2014: 5% of sites

Aug 2014: ~0.1% of sites

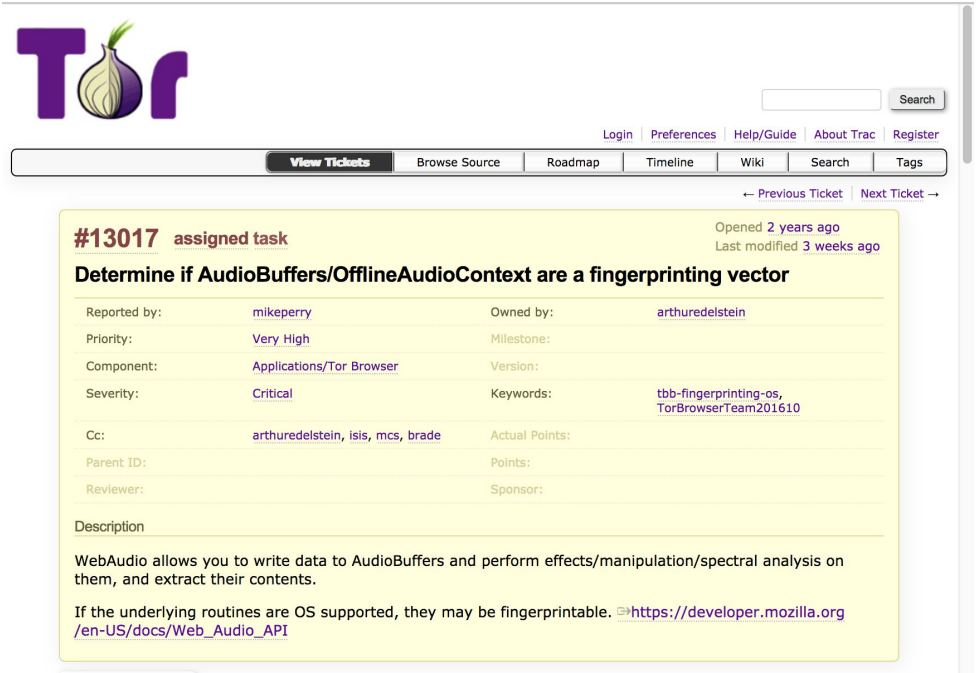
Jan 2016: 2.6% of sites

Percentage of the Alexa top 100k sites

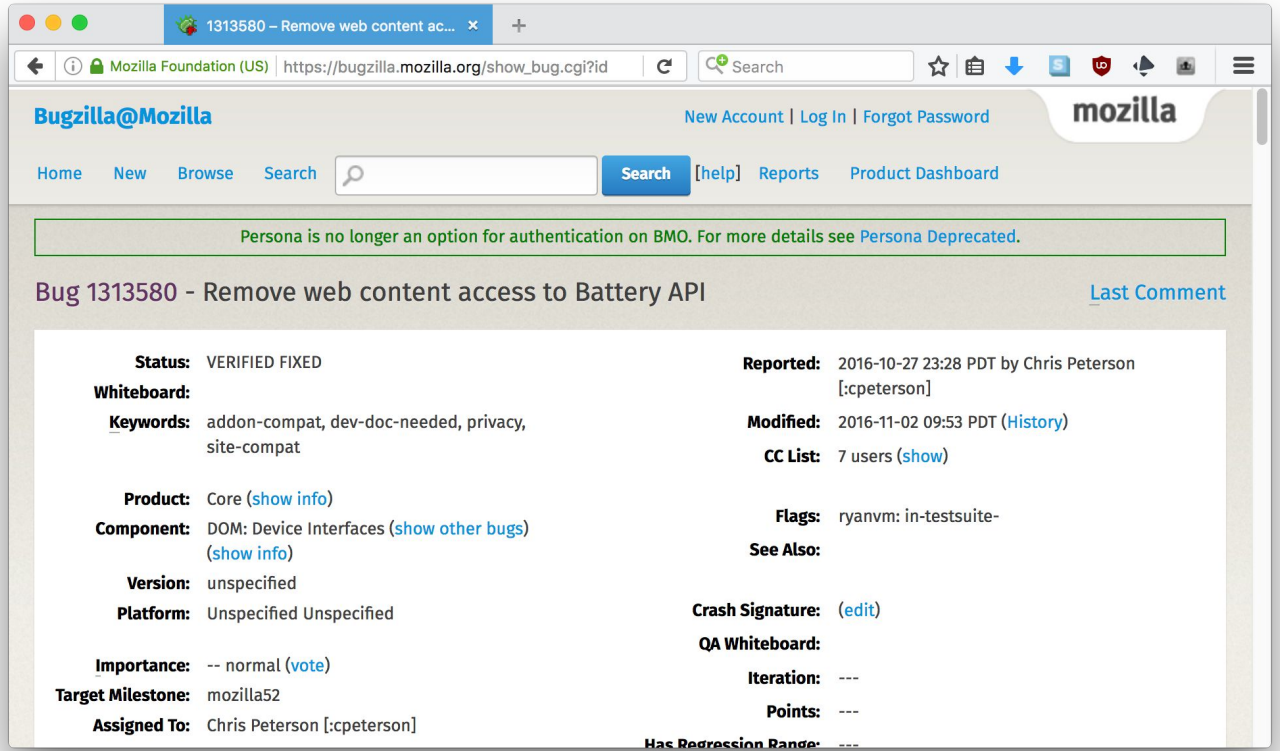
AudioContext fingerprinting the Tor Browser

271 samples from the Tor Browsers

- 7 distinct fingerprints (2 fingerprints account for 80% of samples)
- Overlap with fingerprints from Firefox shows these largely reveal OS of device



Browsers remove BatteryStatus API citing privacy



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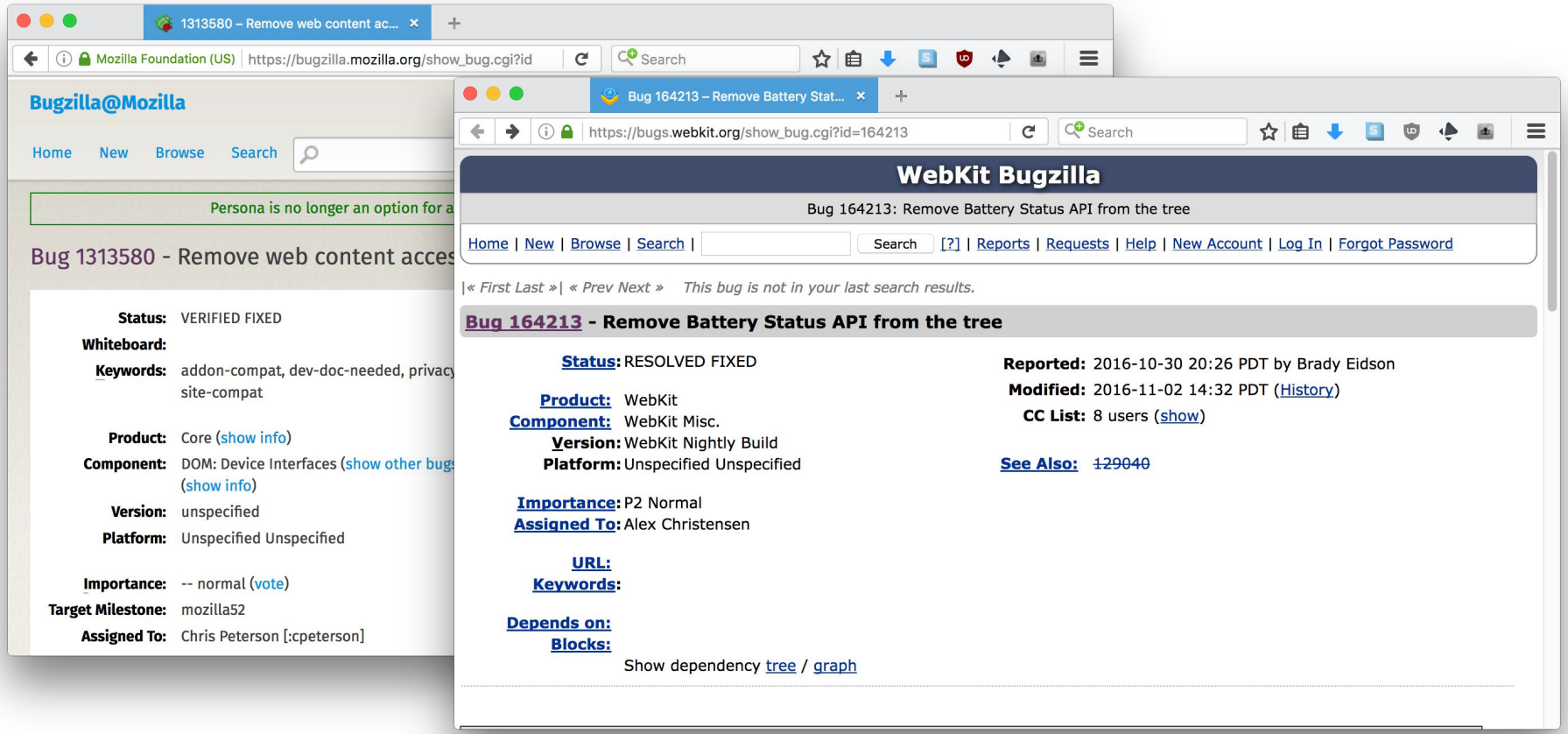
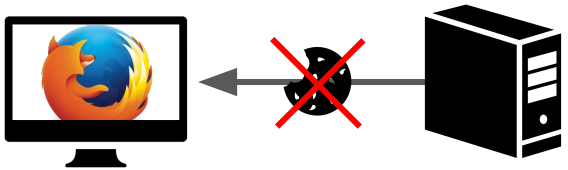


Blocking tools miss less popular trackers & fingerprinters

Ghostery

AdBlock Plus

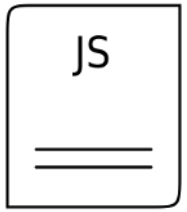


Third-party cookie blocking

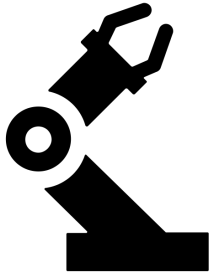
https://webtransparency.cs.princeton.edu/webcensus/

Future directions of the Web Census

Complete instrumentation of JS



Static + dynamic analysis of trackers



Detection of trackers with ML

Blocking tools for users

Our data is available!

Data

The data is available as bzipped PostgreSQL dumps. The schema file used in all of the datasets is available here.

Dataset	Comments
1 Million Site Stateless	Parallel Stateless Crawl
100k Site Stateful	Parallel Stateful Crawl -- 10,000 site seed profile
10k Site ID Detection (1)	Sequential Stateful Crawl -- Flash enabled -- Synced with ID Detection (2)
10k Site ID Detection (2)	Sequential Stateful Crawl -- Flash enabled -- Synced with ID Detection (1)
55k Site Stateless with cookie blocking	Parallel Stateless Crawl -- Firefox set to block all third-party cookies
55k Site Stateless with Ghostery	Parallel Stateless Crawl -- Ghostery extension installed and set to block all possible trackers
55k Site Stateless with HTTPS Everywhere	Parallel Stateless Crawl -- HTTPS Everywhere installed

https://webtransparency.cs.princeton.edu/webcensus/index.html#data

Making data exploration easier

Problem: Querying our data — and making sense of the output — comes with a steep learning curve

```
query = "SELECT DISTINCT res.url, v1.name, v1.value FROM " \
        "http_responses_view as res " \
        "LEFT JOIN http_response_cookies_view as v1 " \
        "ON v1.response_id = res.id " \
        "WHERE res.top_url = %s AND v1.name != ''" \
        " union " \
        "SELECT DISTINCT req.url, v2.name, v2.value FROM " \
        "http_requests_view as req " \
        "LEFT JOIN http_request_cookies_view as v2 " \
        "ON v2.request_id = req.id " \
        "WHERE req.top_url = %s AND v2.name != ''"
```

Making data exploration easier

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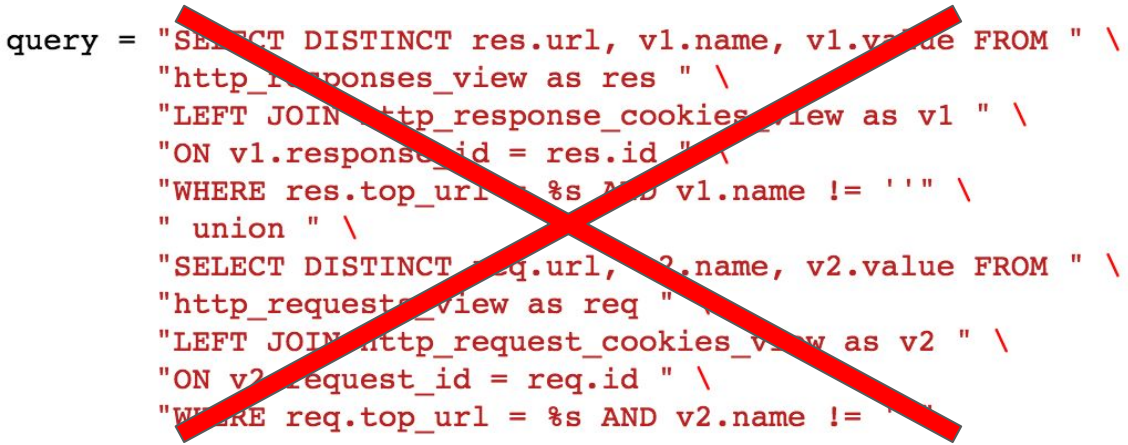

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```

Solution: We are making our data analysis libraries available via Jupyter Notebook!

Census.py

- We'll give you access to our Notebook server, complete with tools that will provide an abstraction layer over our web census data.
- Example API:
  - `get_third_party_responses_by_domain(domain)`
  - `get_cookie_syncs_on_domain(domain)`
  - `is_tracker(url, first_party=False, is_js=True, is_img=False)`
  - `get_trackers(domain)`

Get access: https://groups.google.com/forum/#!forum/web-census-explorers

Example: Getting third party requests by domain

In [14]:

```
results = census.get_third_party_responses_by_domain(con, 'http://nytimes.com')

third_party_trackers = {results[x]['url_ps'] for x in results if results[x]['is_tracker']}

print "Number of third_party trackers on domain: " + str(len(third_party_trackers))

for url in results:
    print url
    print '\tIs a script? ' + str(results[url]['is_js'])
    print '\tIs a tracker? ' + str(results[url]['is_tracker'])
    print '\tPS+1: ' + results[url]['url_ps']
```

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```

```
Number of third_party trackers on domain: 27
https://static01.nyt.com/images/2016/08/18/business/19WHEELS-ss-slide-0LQP/19WHEELS-ss-slide-0LQP-thumbStandard.jpg
        Is a script? False
        Is a tracker? False
        PS+1: nyt.com
https://static01.nyt.com/images/2016/08/03/insider/03insider-savage01/03insider-savage01-thumbStandard-v2.jpg
        Is a script? False
        Is a tracker? False
        PS+1: nyt.com
https://tpc.googlesyndication.com/simgad/15453271384116304559
        Is a script? False
        Is a tracker? True
        PS+1: googlesyndication.com
http://googleads.g.doubleclick.net/pagead/gen_204?id=wfocus&gqid=&qqid=CMqE0Km81c4CFVVcDAodOMoOTQ&fg=1
        Is a script? False
        Is a tracker? True
```

Get access: https://groups.google.com/forum/#!forum/web-census-explorers

Thanks for listening!

Full Paper:
senglehardt.com/papers/ccs16_online_tracking.pdf

Princeton Web Census Data and Analysis:
webtransparency.cs.princeton.edu/webcensus/

Collaborate:
webtap.princeton.edu/research/

Email: ste@cs.princeton.edu **Twitter:** @s_englehardt **Web:** senglehardt.com
dreisman@princeton.edu

Image Assets from the Noun Project:
Robotic Arm by Creative Stall; Browser Network and Browser Battery by Aybige; Computer and Magnifying Glass by Edward Boatman; Server by Yazmin Alanis; Cookie by Rashida Luqman Kheriwala; JS File by Michael Finlay; Blocked Computer by arejoenah