

# Battery Status Not Included: Assessing Privacy in Web Standards



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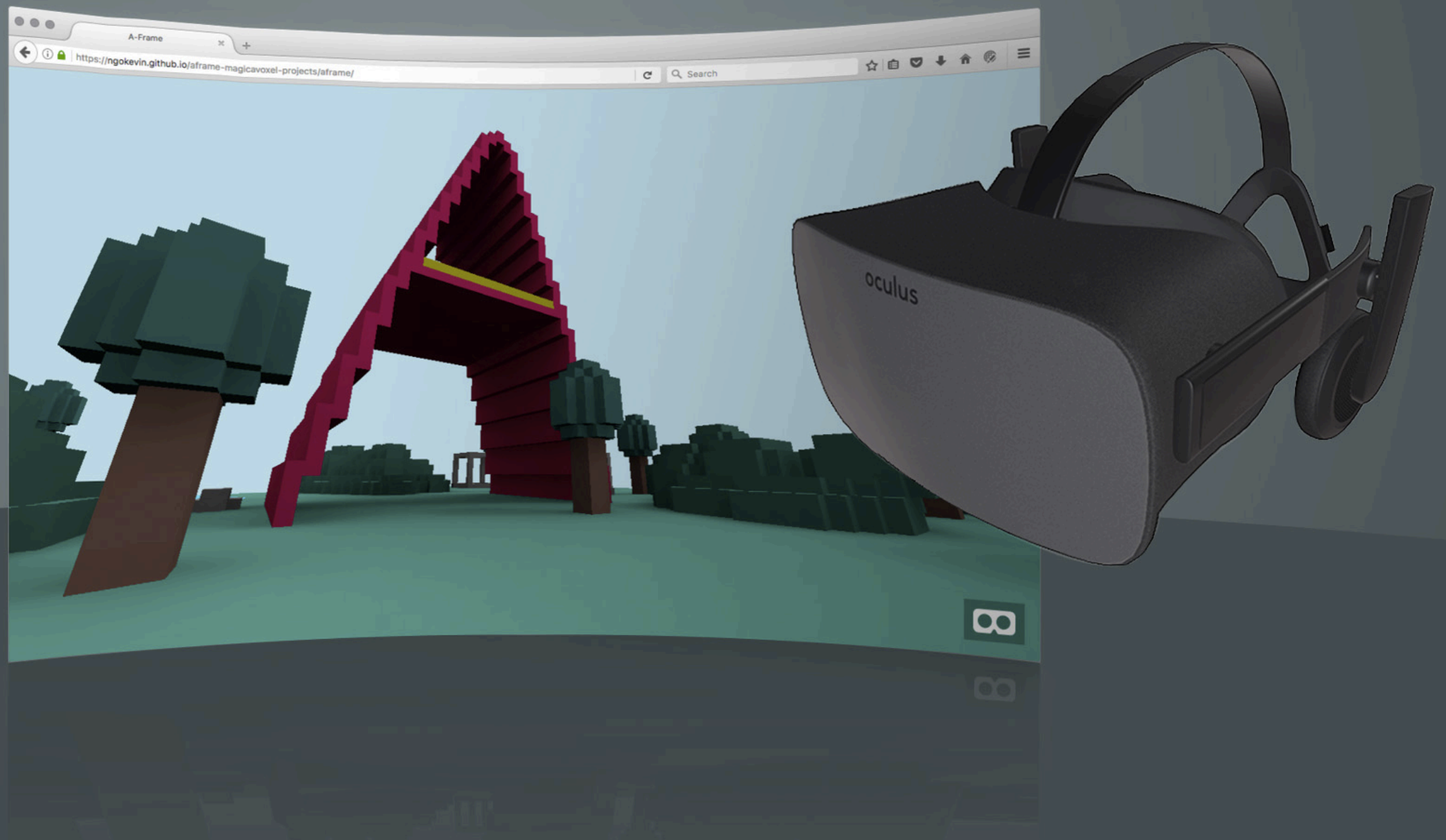
New web features lead to privacy concerns

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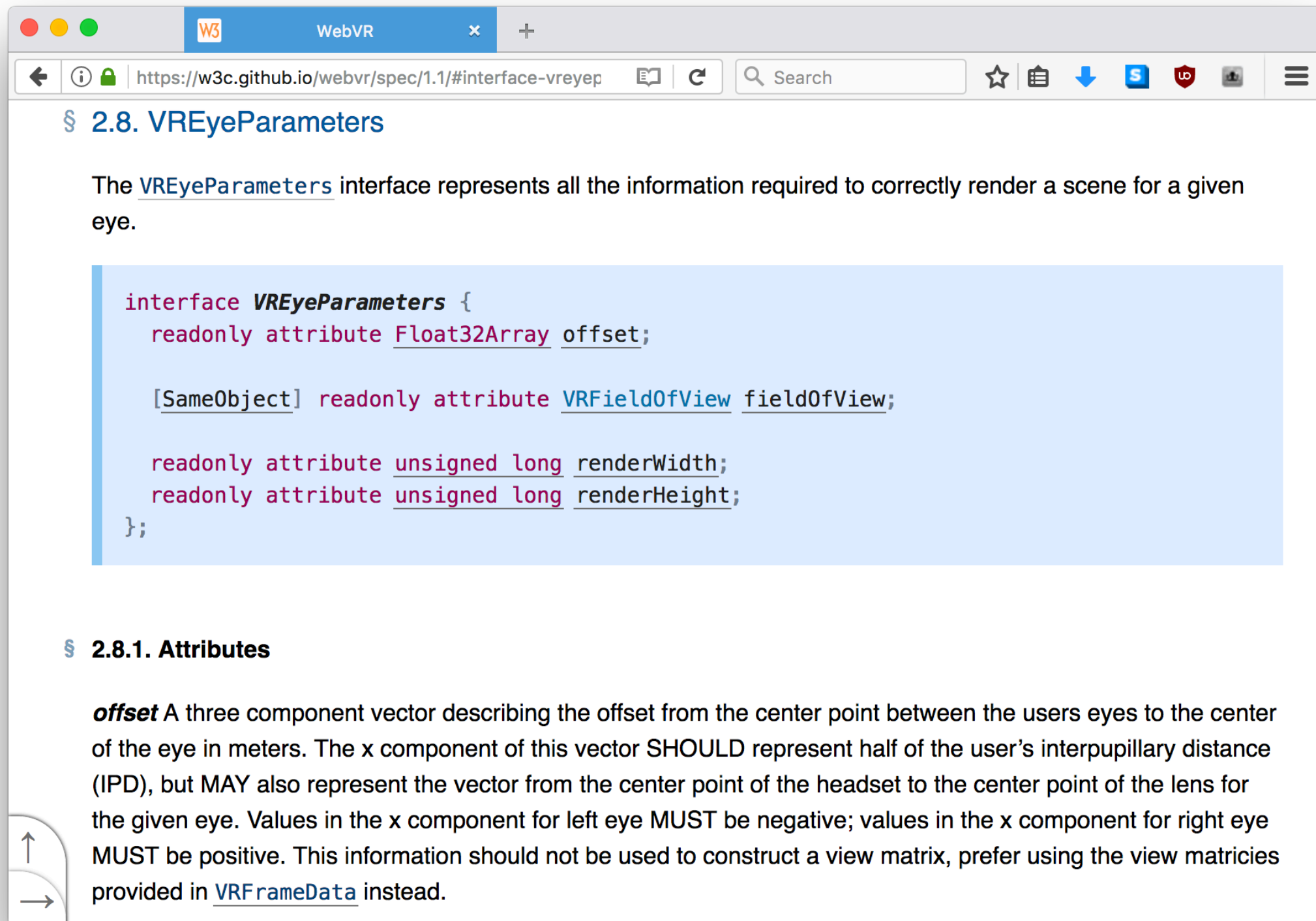




# New web features lead to privacy concerns



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The screenshot shows a web browser window with the title 'WebVR'. The address bar displays the URL 'https://w3c.github.io/webvr/spec/1.1/#interface-vreyep'. The page content is titled '§ 2.8. VREyeParameters'. Below the title, a paragraph explains that the `VREyeParameters` interface represents information required to render a scene for a given eye. A code block shows the interface definition in JavaScript. Below the code block, a sub-section '§ 2.8.1. Attributes' describes the `offset` attribute, explaining it as a three-component vector representing the offset from the center point between the user's eyes to the center of the eye in meters. It notes that the x component should represent half the user's interpupillary distance (IPD) but may also represent the vector from the headset center to the lens center for the given eye. It specifies that x values for the left eye must be negative and for the right eye must be positive, and advises against using this information to construct a view matrix, preferring view matrices from `VRFrameData`.

§ 2.8. VREyeParameters

The `VREyeParameters` interface represents all the information required to correctly render a scene for a given eye.

```
interface VREyeParameters {  
  readonly attribute Float32Array offset;  
  
  [SameObject] readonly attribute VRFieldOfView fieldOfView;  
  
  readonly attribute unsigned long renderWidth;  
  readonly attribute unsigned long renderHeight;  
};
```

§ 2.8.1. Attributes

**offset** A three component vector describing the offset from the center point between the users eyes to the center of the eye in meters. The x component of this vector SHOULD represent half of the user's interpupillary distance (IPD), but MAY also represent the vector from the center point of the headset to the center point of the lens for the given eye. Values in the x component for left eye MUST be negative; values in the x component for right eye MUST be positive. This information should not be used to construct a view matrix, prefer using the view matrices provided in `VRFrameData` instead.

# New web features lead to privacy concerns

WebVR

https://w3c.github.io/webvr/spec/1.1/#interface-vreyep

Search

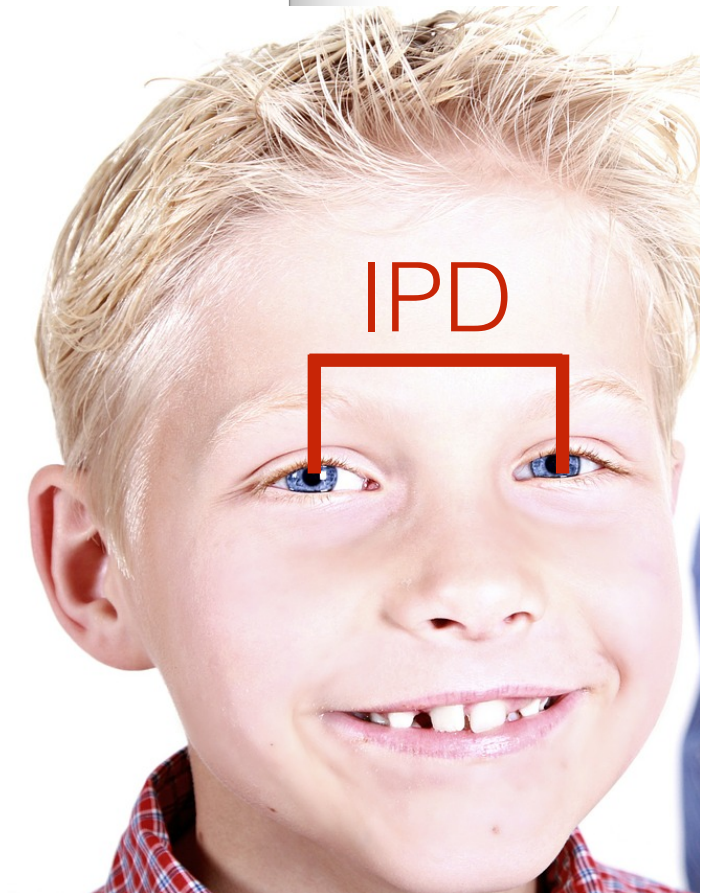
## § 2.8. VREyeParameters

The [VREyeParameters](#) interface represents all the information required to correctly render a scene for an eye.

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interface VREyeParameters {  
  readonly attribute Float32Array offset;  
  
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### § 2.8.1. Attributes

**offset** A three component vector describing the offset from the center point between the user's eyes to the eye in meters. The x component of this vector SHOULD represent half of the user's interpupillary distance (IPD), but MAY also represent the vector from the center point of the headset to the center point of the lens for the given eye. Values in the x component for left eye MUST be negative; values in the x component for right eye MUST be positive. This information should not be used to construct a view matrix, prefer using the view matrices provided in [VRFrameData](#) instead.



# The W3C has a self-review questionnaire

W3C Working Group Note



## Self-Review Questionnaire: Security and Privacy


### W3C Working Group Note 10 December 2015

**This version:**  
<http://www.w3.org/TR/2015/NOTE-security-privacy-questionnaire-20151210/>

**Latest published version:**  
<http://www.w3.org/TR/security-privacy-questionnaire/>

**Editor's Draft:**  
<https://w3ctag.github.io/security-questionnaire/>

**Editor:**  
Mike West, Google Inc., [mkwst@google.com](mailto:mkwst@google.com)

 To the extent possible under law, the editors have waived all copyright and related or neighboring rights to this work. This document is also made available under the [W3C Software and Document License](#).

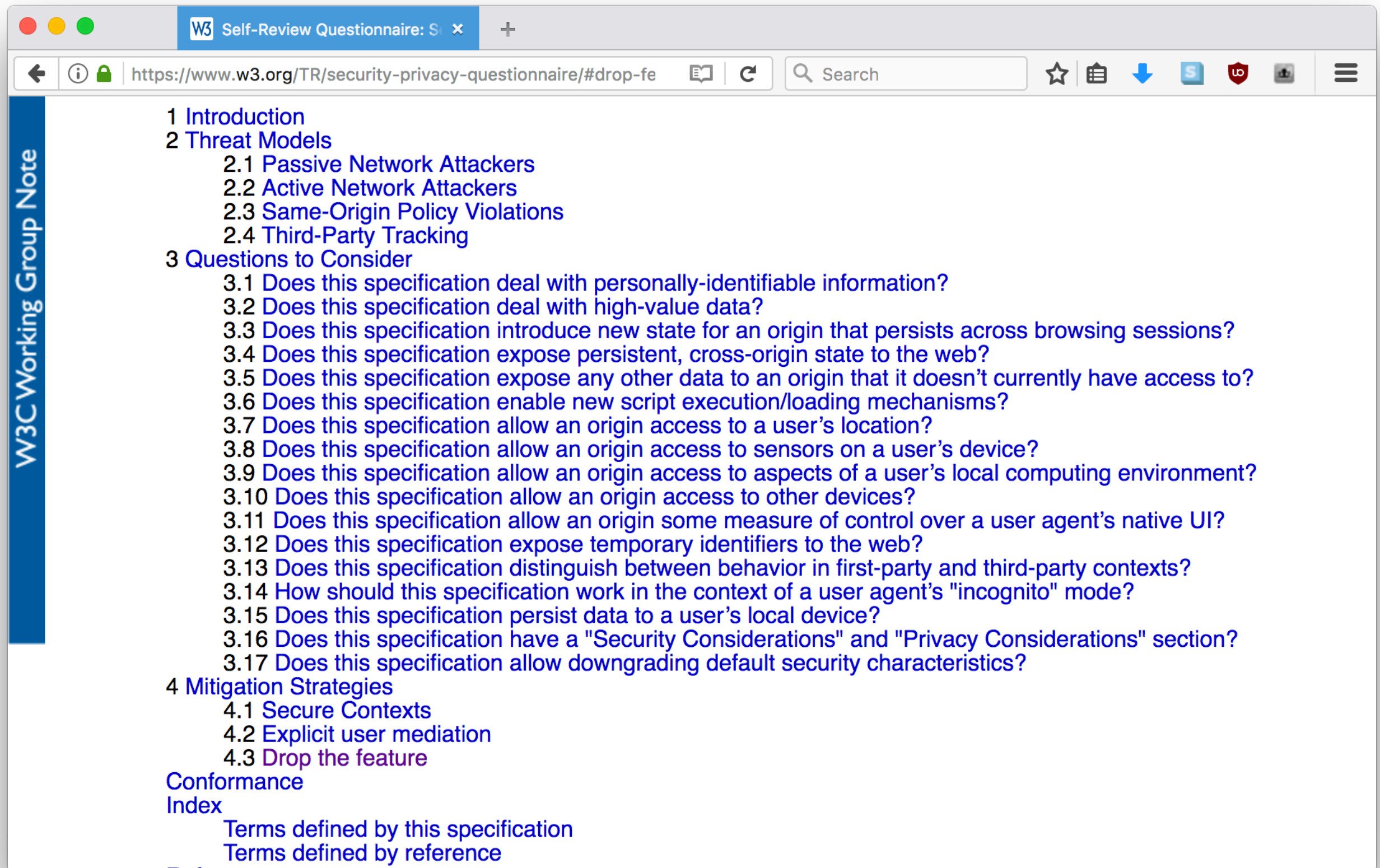
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## Abstract

This document lists a set of questions one could ask about the security and privacy impact of a new feature or specification. It is meant as a tool that groups or individuals can use as a guide during a self-review, pointing towards important questions in areas where expertise might be lacking.



# The W3C has a self-review questionnaire



The screenshot shows a web browser window with the title "W3 Self-Review Questionnaire: S" and the URL "https://www.w3.org/TR/security-privacy-questionnaire/#drop-fe". The page content is a list of questions and sections for a self-review questionnaire. A vertical blue bar on the left side of the page contains the text "W3C Working Group Note".

- 1 Introduction
- 2 Threat Models
  - 2.1 Passive Network Attackers
  - 2.2 Active Network Attackers
  - 2.3 Same-Origin Policy Violations
  - 2.4 Third-Party Tracking
- 3 Questions to Consider
  - 3.1 Does this specification deal with personally-identifiable information?
  - 3.2 Does this specification deal with high-value data?
  - 3.3 Does this specification introduce new state for an origin that persists across browsing sessions?
  - 3.4 Does this specification expose persistent, cross-origin state to the web?
  - 3.5 Does this specification expose any other data to an origin that it doesn't currently have access to?
  - 3.6 Does this specification enable new script execution/loading mechanisms?
  - 3.7 Does this specification allow an origin access to a user's location?
  - 3.8 Does this specification allow an origin access to sensors on a user's device?
  - 3.9 Does this specification allow an origin access to aspects of a user's local computing environment?
  - 3.10 Does this specification allow an origin access to other devices?
  - 3.11 Does this specification allow an origin some measure of control over a user agent's native UI?
  - 3.12 Does this specification expose temporary identifiers to the web?
  - 3.13 Does this specification distinguish between behavior in first-party and third-party contexts?
  - 3.14 How should this specification work in the context of a user agent's "incognito" mode?
  - 3.15 Does this specification persist data to a user's local device?
  - 3.16 Does this specification have a "Security Considerations" and "Privacy Considerations" section?
  - 3.17 Does this specification allow downgrading default security characteristics?
- 4 Mitigation Strategies
  - 4.1 Secure Contexts
  - 4.2 Explicit user mediation
  - 4.3 Drop the feature
- Conformance
- Index
  - Terms defined by this specification
  - Terms defined by reference



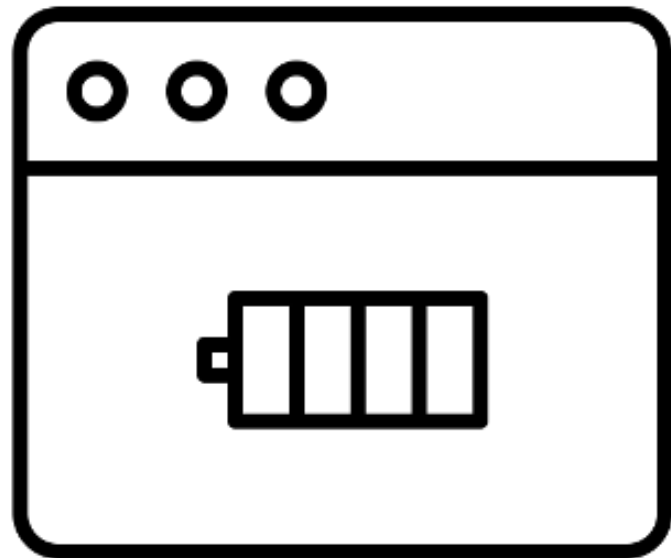
# W3C Privacy Interest Group (PING) offers guidance and reviews

The mission...is to improve the support of privacy in Web standards by:

1. Monitoring ongoing privacy issues that affect the Web
2. Investigating potential areas for new privacy work
3. Providing guidelines and advice for addressing privacy in standards development.

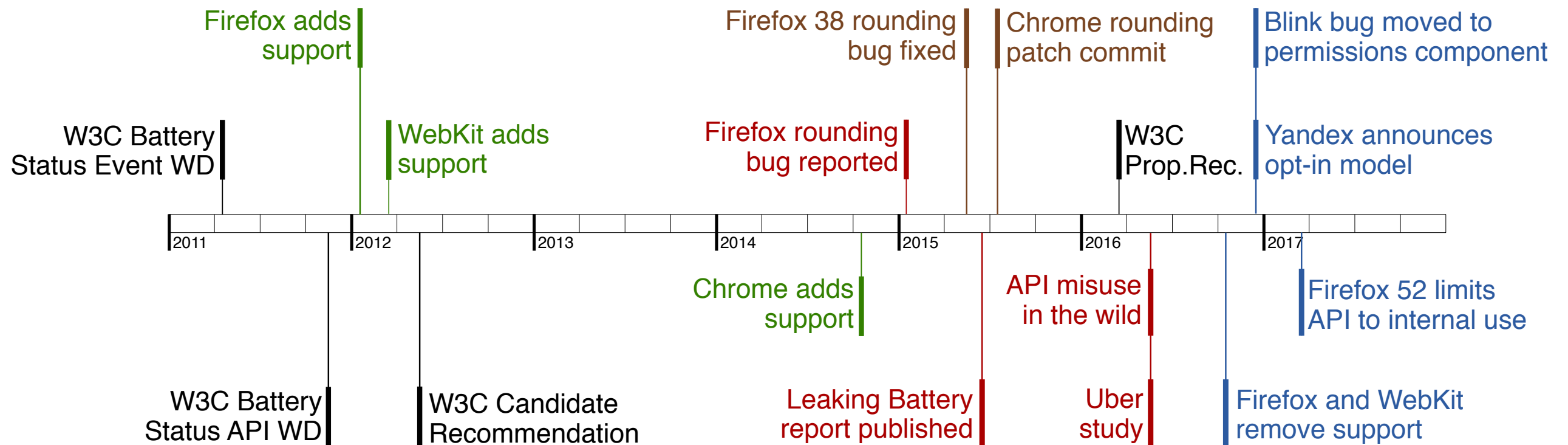
*<https://www.w3.org/2011/07/privacy-ig-charter>*

# The Battery Status API



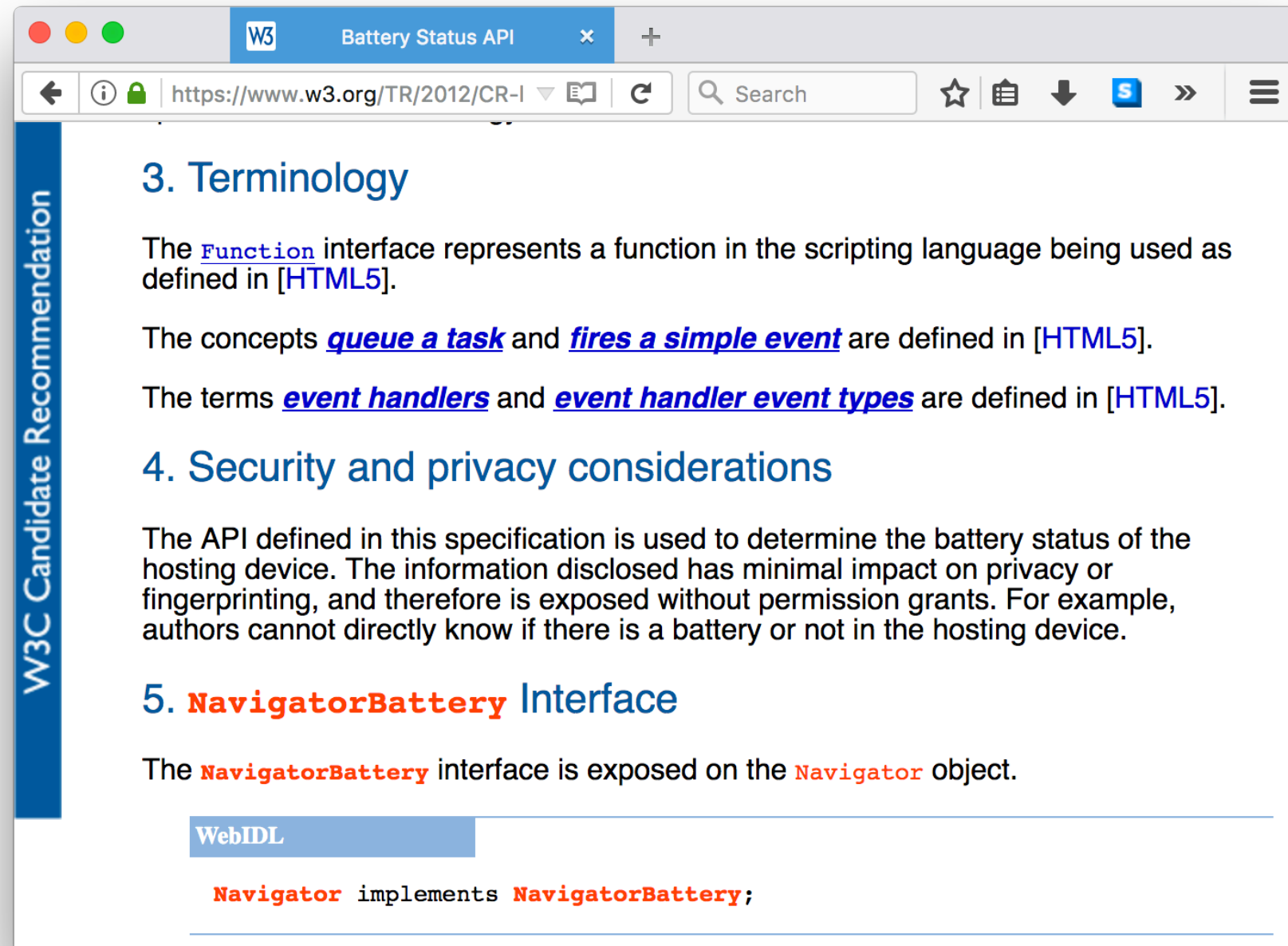
- charge **level**
  - value between 0 and 1
  - e.g 0.43 if the battery at 43%
- **charging** status
  - boolean indicator
- time to charge or discharge
  - **dischargingTime**
  - **chargingTime**
  - time in seconds

# The development and adoption of the API





# Mid 2012: Candidate Recommendation adds security and privacy considerations



# Mid 2012: Candidate Recommendation adds security and privacy considerations

The screenshot shows a web browser window displaying the W3C Battery Status API Candidate Recommendation document. The browser's address bar shows the URL <https://www.w3.org/TR/2012/CR-I>. The document is titled "Battery Status API" and is part of the "W3C Candidate Recommendation" series. The document is divided into sections: "3. Terminology", "4. Security and privacy considerations", and "5. NavigatorBattery Interface". A red arrow points from a callout box to the "4. Security and privacy considerations" section. The callout box contains the text: "the information disclosed has a **minimal impact** on privacy or fingerprinting".

W3C Candidate Recommendation

### 3. Terminology

The [Function](#) interface represents a function in the scripting language defined in [HTML5].

The concepts [queue a task](#) and [fires a simple event](#) are defined.

The terms [event handlers](#) and [event handler event types](#) are defined.

### 4. Security and privacy considerations

The API defined in this specification is used to determine the battery status of the hosting device. The information disclosed has minimal impact on privacy or fingerprinting, and therefore is exposed without permission grants. For example, authors cannot directly know if there is a battery or not in the hosting device.

### 5. NavigatorBattery Interface

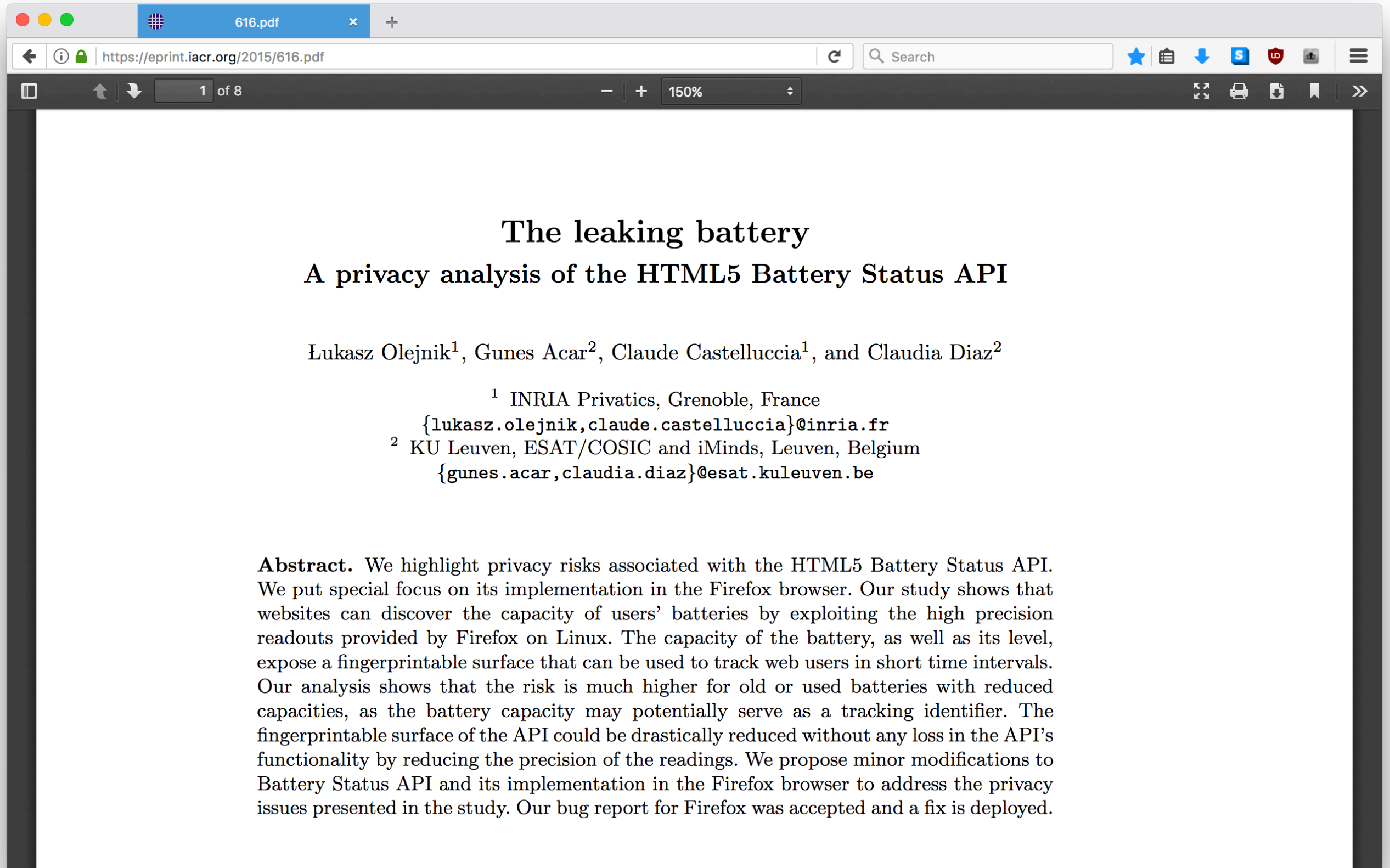
The [NavigatorBattery](#) interface is exposed on the [Navigator](#) object.

---

WebIDL

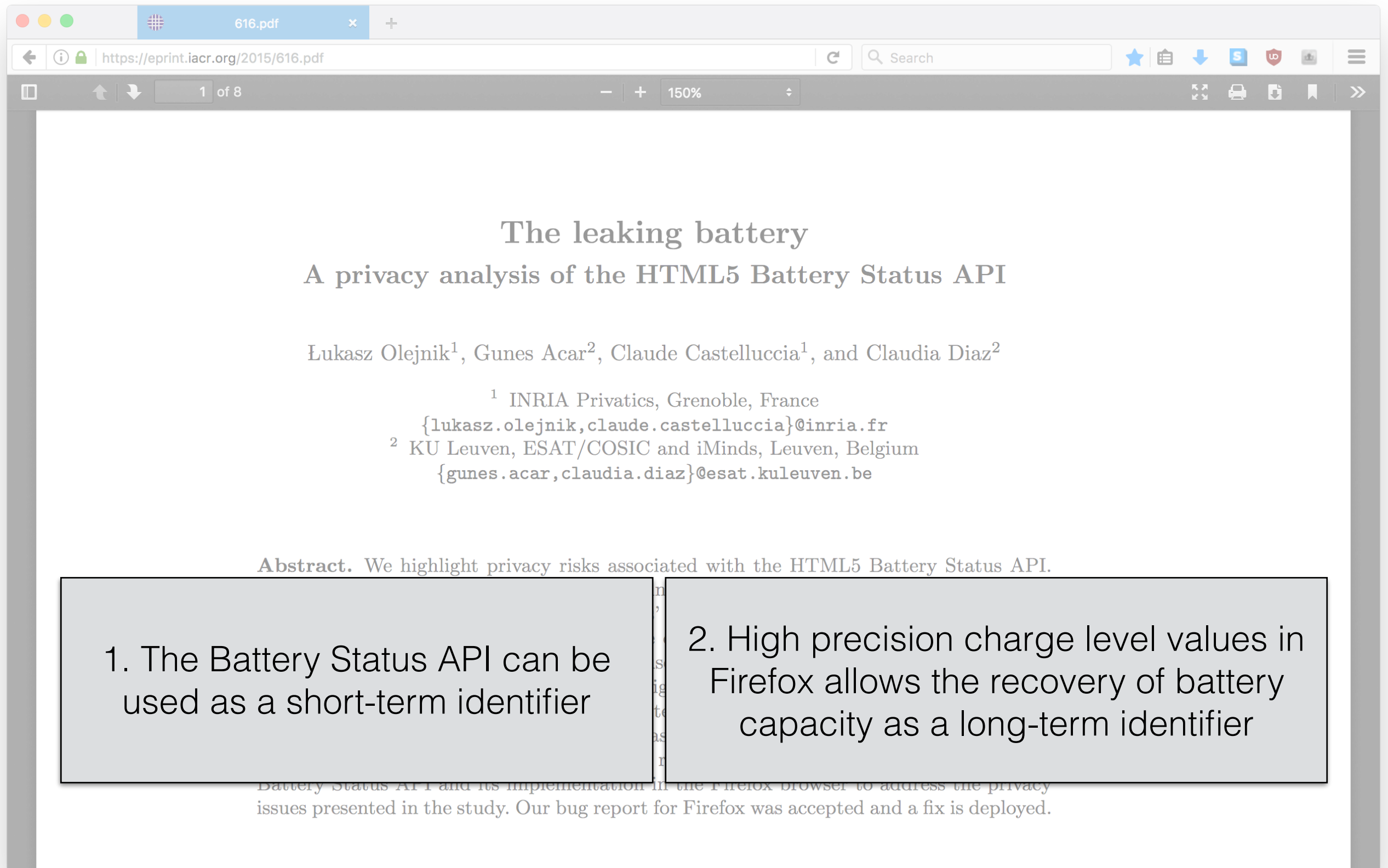
```
Navigator implements NavigatorBattery;
```

# New research exposes multiple privacy vulnerabilities





# New research exposes multiple privacy vulnerabilities



The screenshot shows a PDF viewer window with a single tab titled '616.pdf'. The address bar displays the URL 'https://eprint.iacr.org/2015/616.pdf'. The document's title is 'The leaking battery', followed by the subtitle 'A privacy analysis of the HTML5 Battery Status API'. The authors listed are 'Lukasz Olejnik<sup>1</sup>, Gunes Acar<sup>2</sup>, Claude Castelluccia<sup>1</sup>, and Claudia Diaz<sup>2</sup>'. Affiliations are provided for the first two authors: '<sup>1</sup> INRIA Privatics, Grenoble, France' and '{lukasz.olejnik,claudie.castelluccia}@inria.fr' for the first, and '<sup>2</sup> KU Leuven, ESAT/COSIC and iMinds, Leuven, Belgium' and '{gunes.acar,claudia.diaz}@esat.kuleuven.be' for the second. The abstract states: 'Abstract. We highlight privacy risks associated with the HTML5 Battery Status API.' Below the abstract, two grey boxes highlight specific findings: '1. The Battery Status API can be used as a short-term identifier' and '2. High precision charge level values in Firefox allows the recovery of battery capacity as a long-term identifier'. At the bottom, a line of text reads: 'Battery Status API and its implementation in the Firefox browser to address the privacy issues presented in the study. Our bug report for Firefox was accepted and a fix is deployed.'

616.pdf

https://eprint.iacr.org/2015/616.pdf

1 of 8 150%

## The leaking battery

### A privacy analysis of the HTML5 Battery Status API

Lukasz Olejnik<sup>1</sup>, Gunes Acar<sup>2</sup>, Claude Castelluccia<sup>1</sup>, and Claudia Diaz<sup>2</sup>

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{lukasz.olejnik,claudie.castelluccia}@inria.fr

<sup>2</sup> KU Leuven, ESAT/COSIC and iMinds, Leuven, Belgium  
{gunes.acar,claudia.diaz}@esat.kuleuven.be

**Abstract.** We highlight privacy risks associated with the HTML5 Battery Status API.

1. The Battery Status API can be used as a short-term identifier

2. High precision charge level values in Firefox allows the recovery of battery capacity as a long-term identifier

Battery Status API and its implementation in the Firefox browser to address the privacy issues presented in the study. Our bug report for Firefox was accepted and a fix is deployed.

# New research exposes multiple privacy vulnerabilities

The screenshot shows a web browser window with a single tab titled 'ccs16\_online\_tracking.pdf'. The address bar shows the URL 'https://senglehardt.com/papers/ccs16\_online\_tracking.pdf'. The browser interface includes a search bar, navigation buttons, and a toolbar with icons for zooming, printing, and other functions. The document content is displayed in a white area with a dark sidebar on the left. The title 'Online Tracking: A 1-million-site Measurement and Analysis' is centered at the top of the document. Below the title are the authors' names and affiliations. A blue text line states that this is an extended version of a paper from ACM CCS 2016. The abstract section follows, starting with the word 'ABSTRACT' in bold. The abstract text describes a large-scale measurement of online tracking on 1 million websites, mentioning various tracking techniques and the use of an open-source tool called OpenWPM. The text is formatted with some words in red and green boxes, likely for highlighting or citation purposes.

ccs16\_online\_tracking.pdf

https://senglehardt.com/papers/ccs16\_online\_tracking.pdf

## Online Tracking: A 1-million-site Measurement and Analysis

Steven Englehardt  
Princeton University  
ste@cs.princeton.edu

Arvind Narayanan  
Princeton University  
arvindn@cs.princeton.edu

This is an extended version of our paper that appeared at ACM CCS 2016.

### ABSTRACT

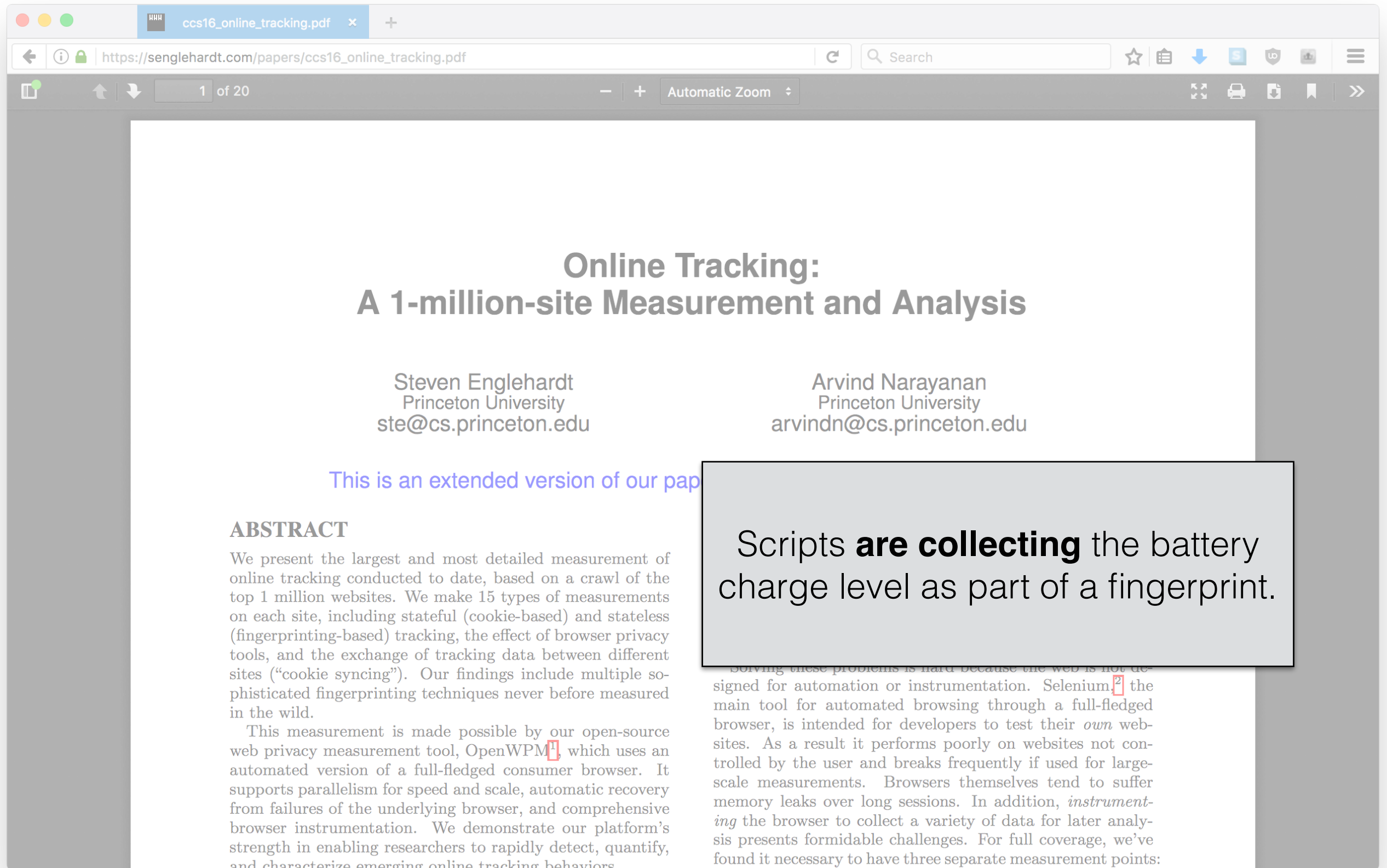
We present the largest and most detailed measurement of online tracking conducted to date, based on a crawl of the top 1 million websites. We make 15 types of measurements on each site, including stateful (cookie-based) and stateless (fingerprinting-based) tracking, the effect of browser privacy tools, and the exchange of tracking data between different sites (“cookie syncing”). Our findings include multiple sophisticated fingerprinting techniques never before measured in the wild.

This measurement is made possible by our open-source web privacy measurement tool, OpenWPM<sup>1</sup>, which uses an automated version of a full-fledged consumer browser. It supports parallelism for speed and scale, automatic recovery from failures of the underlying browser, and comprehensive browser instrumentation. We demonstrate our platform’s strength in enabling researchers to rapidly detect, quantify, and characterize emerging online tracking behaviors

to resort to a stripped-down browser <sup>31</sup> (a limitation we explore in detail in Section 3.3). (2) We provide comprehensive instrumentation by expanding on the rich browser extension instrumentation of FourthParty <sup>33</sup>, without requiring the researcher to write their own automation code. (3) We reduce duplication of work by providing a modular architecture to enable code re-use between studies.

Solving these problems is hard because the web is not designed for automation or instrumentation. Selenium<sup>2</sup>, the main tool for automated browsing through a full-fledged browser, is intended for developers to test their *own* websites. As a result it performs poorly on websites not controlled by the user and breaks frequently if used for large-scale measurements. Browsers themselves tend to suffer memory leaks over long sessions. In addition, *instrumenting* the browser to collect a variety of data for later analysis presents formidable challenges. For full coverage, we’ve found it necessary to have three separate measurement points:

# New research exposes multiple privacy vulnerabilities





# The specification was updated to address privacy vulnerabilities

1. Should avoid high precision readouts
2. Should inform the user when and who is using the API
3. May ask the user for permission
4. May obfuscate or expose fake values

Late 2016: Mozilla proposes removing the API, citing privacy concerns and lack of use

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**Question:**

“Can anyone point to a real website using the Battery API for a legitimate purpose?”



Late 2016: Mozilla proposes removing the API, citing privacy concerns and lack of use

### **Question:**

“Can anyone point to a real website using the Battery API for a legitimate purpose?”

### **Conclusion:**

“Everyone agrees there are theoretical good things that can be done with the battery API; we just don't observe them being done.”

# Early 2017: Several vendors remove or restrict support, citing privacy and lack of use



Restricted to non-web content



Removed from source code



Open bug (unknown?)



Yandex.Browser

Opt-in, otherwise dummy values

# Our data supports Mozilla's decision

We measured usage on the top 50,000 sites

33 third-parties on 815 sites use the API

- 16 used it for tracking
  - Mostly fingerprinting
- 8 used it for benign purposes
  - Mostly performance measurement
- 9 unclassified

How can we improve the  
privacy review process?



The specification process should include  
a privacy review of implementations

Specification requires two implementations to progress

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Why not require a privacy review of these specifications?

The specification process should include  
a privacy review of implementations

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Why not require a privacy review of these specifications?

—> Similar precision issues found during privacy review of Ambient Light Sensors API, which included implementation auditing.

API use in the wild should be audited after implementation

**Trackers are the early adopters of any new API!**

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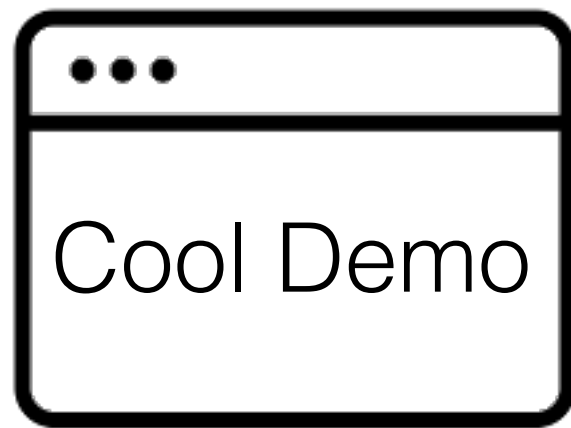
Intended Uses

Unintended Uses



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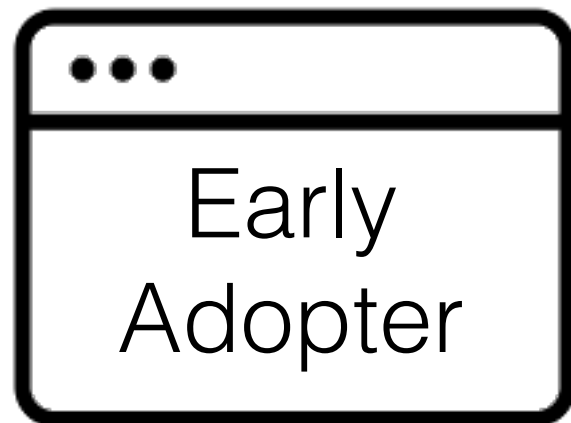
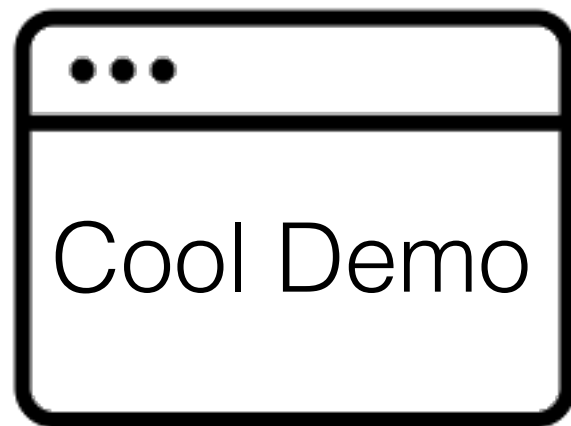
Intended Uses



Unintended Uses

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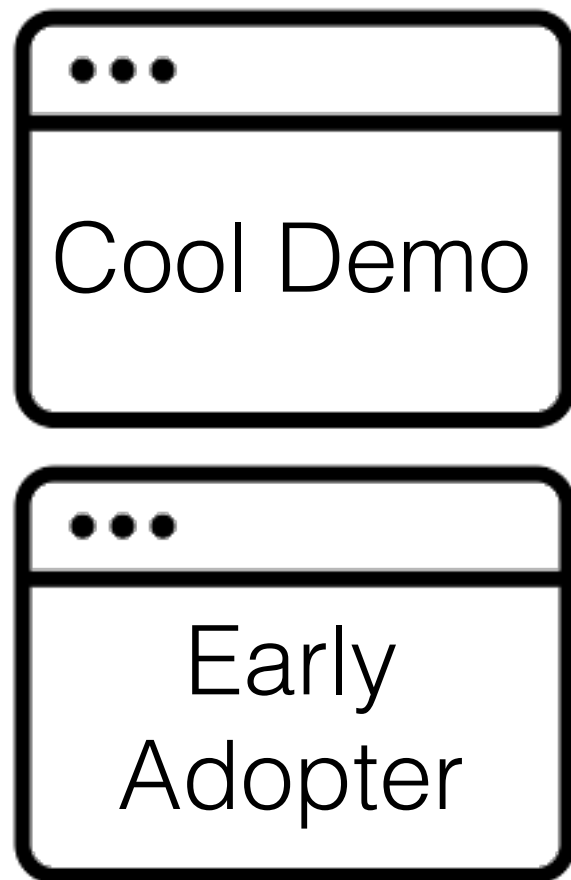
Intended Uses



Unintended Uses

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## Intended Uses

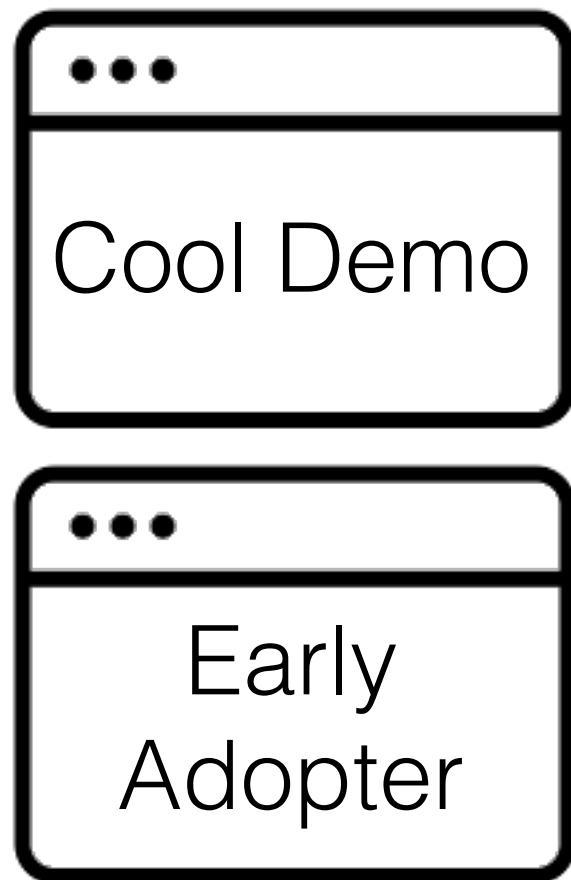


## Unintended Uses

Implemented  
by a tracker

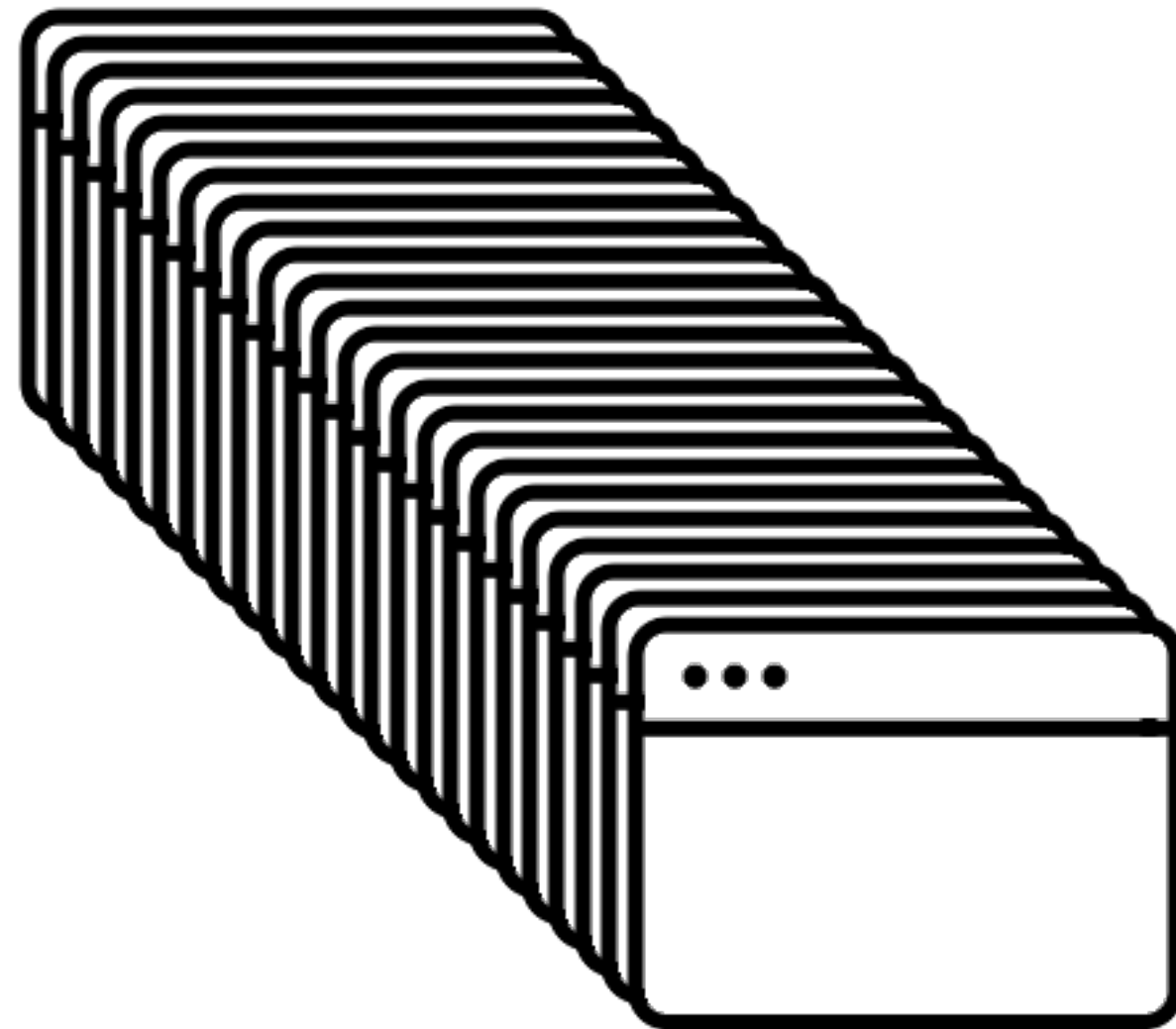
# Trackers are the early adopters of any new API!

## Intended Uses



## Unintended Uses

Implemented  
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API use in the wild should be audited after implementation

**It's not clear that the measurement community will continue to support fingerprinting measurement**



# API use in the wild should be audited after implementation

**It's not clear that the measurement community will continue to support fingerprinting measurement**

**Concerns:**

1. Lack of novelty in measurement techniques
2. Measurement of each new API is a small contribution
3. Specifications can't wait for the publication cycle

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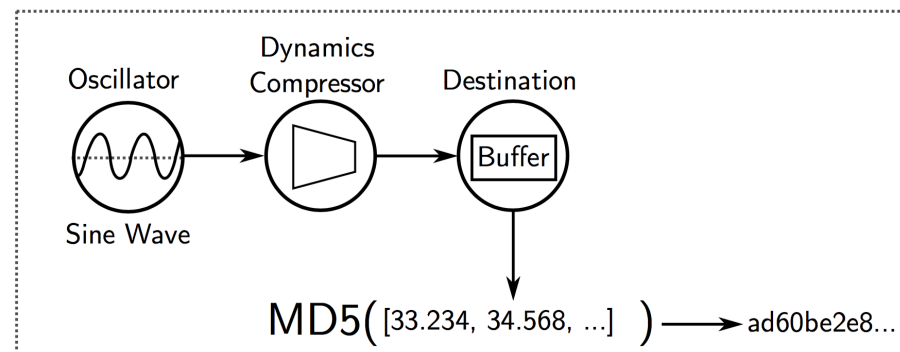
1. Lack of novelty in measurement techniques
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## **Suggestions:**

1. Measurement through browser telemetry probes?
2. Regular measurement by browser vendors?
3. Public measurements by an NGO — something like [archive.org](https://archive.org)

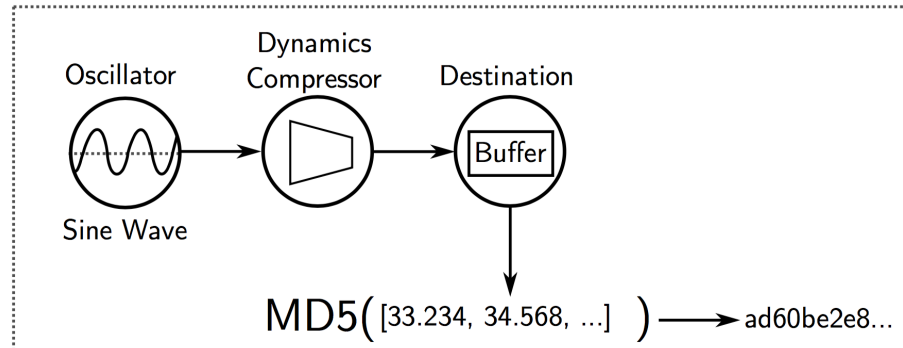
Specification authors should carry out privacy assessments with multiple threat models

## **An example: fingerprinting with the Audio API**



Specification authors should carry out privacy assessments with multiple threat models

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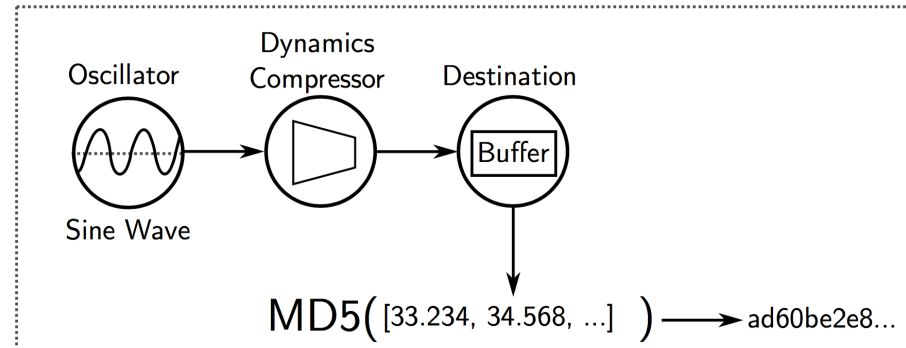


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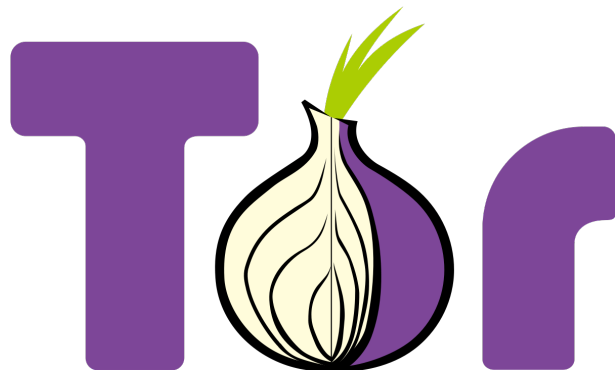
User's OS and  
browser

Specification authors should carry out privacy assessments with multiple threat models

## An example: fingerprinting with the Audio API



≈ User's OS and browser



This is a concern for the Tor Browser!

# Thank you!

In summary:

1. Improve incentives for academics to contribute research
- 2. Include audits of implementations in reviews**
- 3. Audit API use after deployment**
- 4. Carry out analysis in multiple threat models**
5. Avoiding over-specification supports innovative solutions
6. Provide guidance for web developers in addition to vendors

**Full paper:**

**[https://senglehardt.com/papers/iwpe17\\_battery\\_status\\_case\\_study.pdf](https://senglehardt.com/papers/iwpe17_battery_status_case_study.pdf)**

Image assets from the Noun Project:

Browser Battery by Aybige, Browser Window by amy morgan