Measuring and Disrupting Anti-Adblockers Using Differential Execution Analysis

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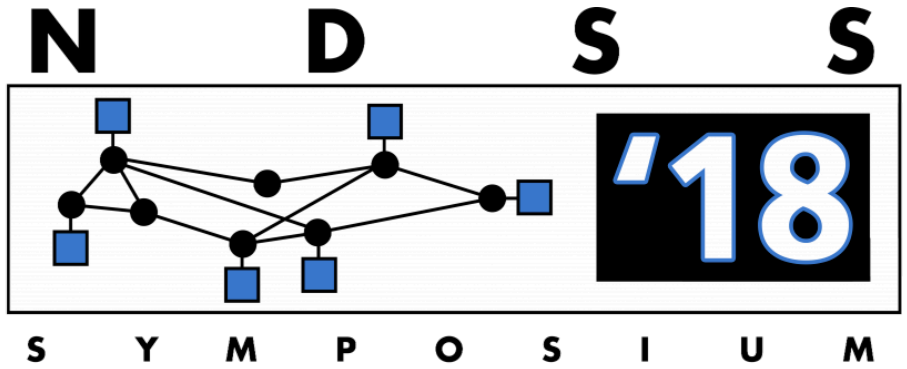
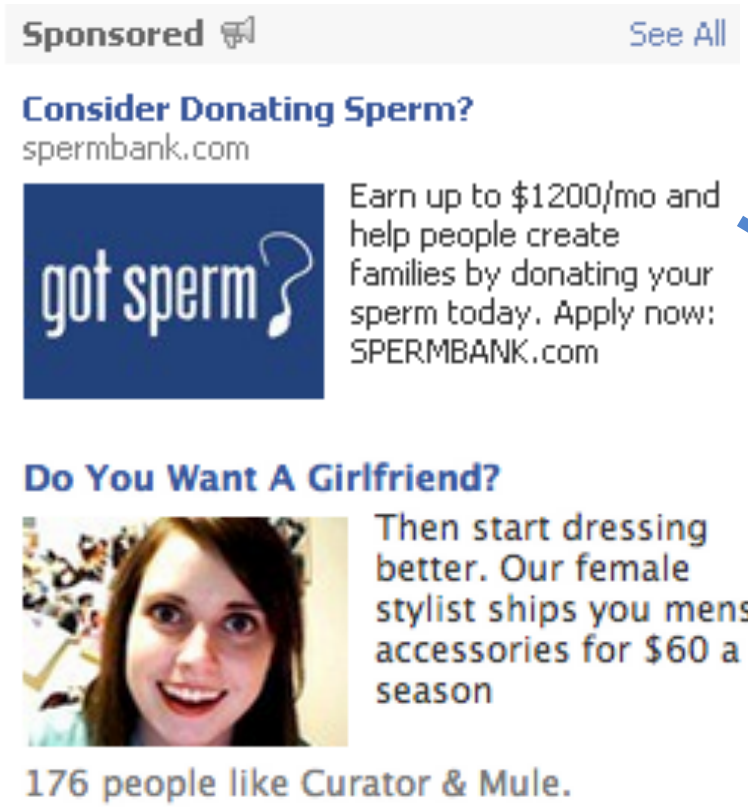


[1] *Ad blocking rapidly escalating, says researcher* https://www.networkworld.com/article/2166999/tech-primer/ad-blocking-rapidly-escalating-says-researcher.html

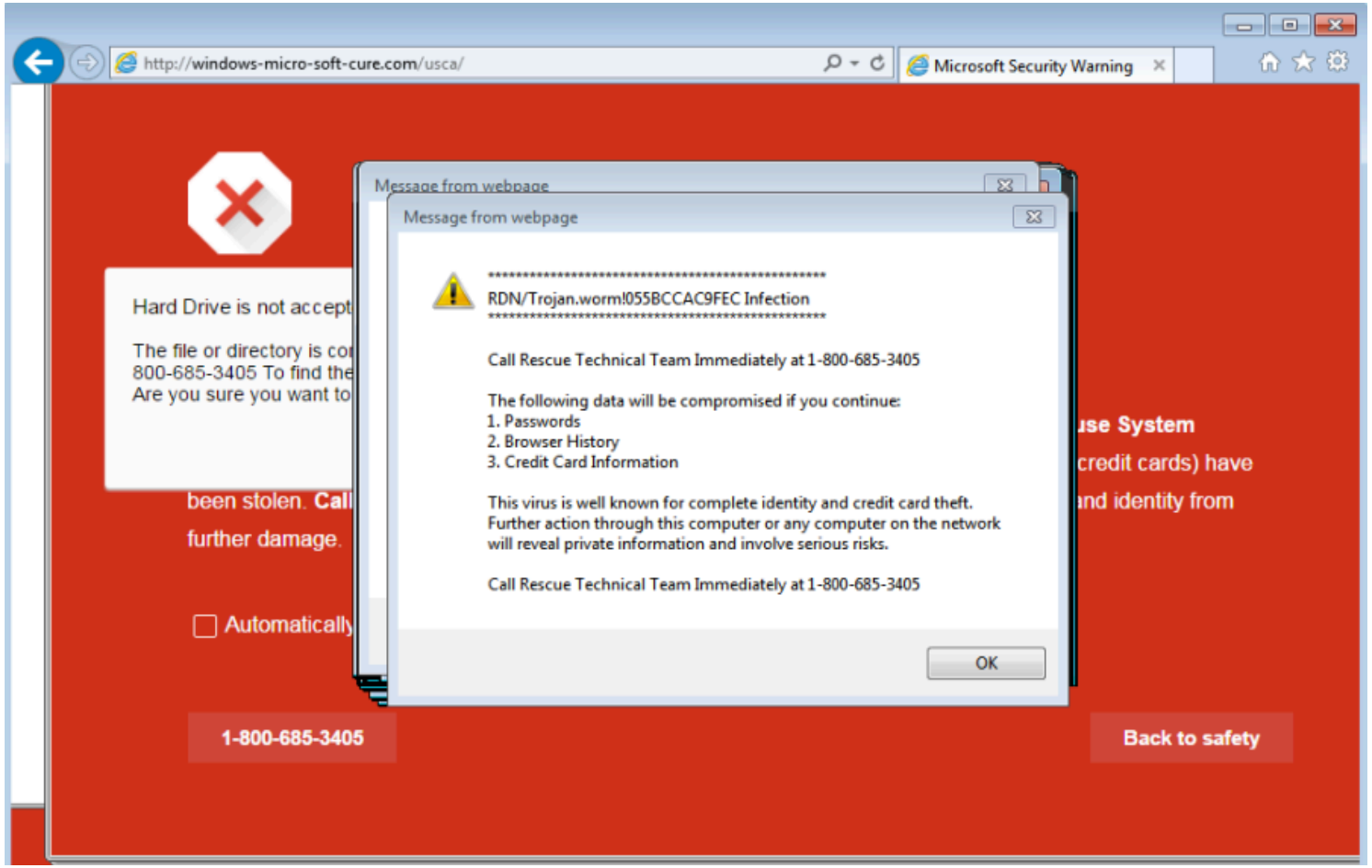
Web Tracking & Ads



tracking-fueled/ conciseness

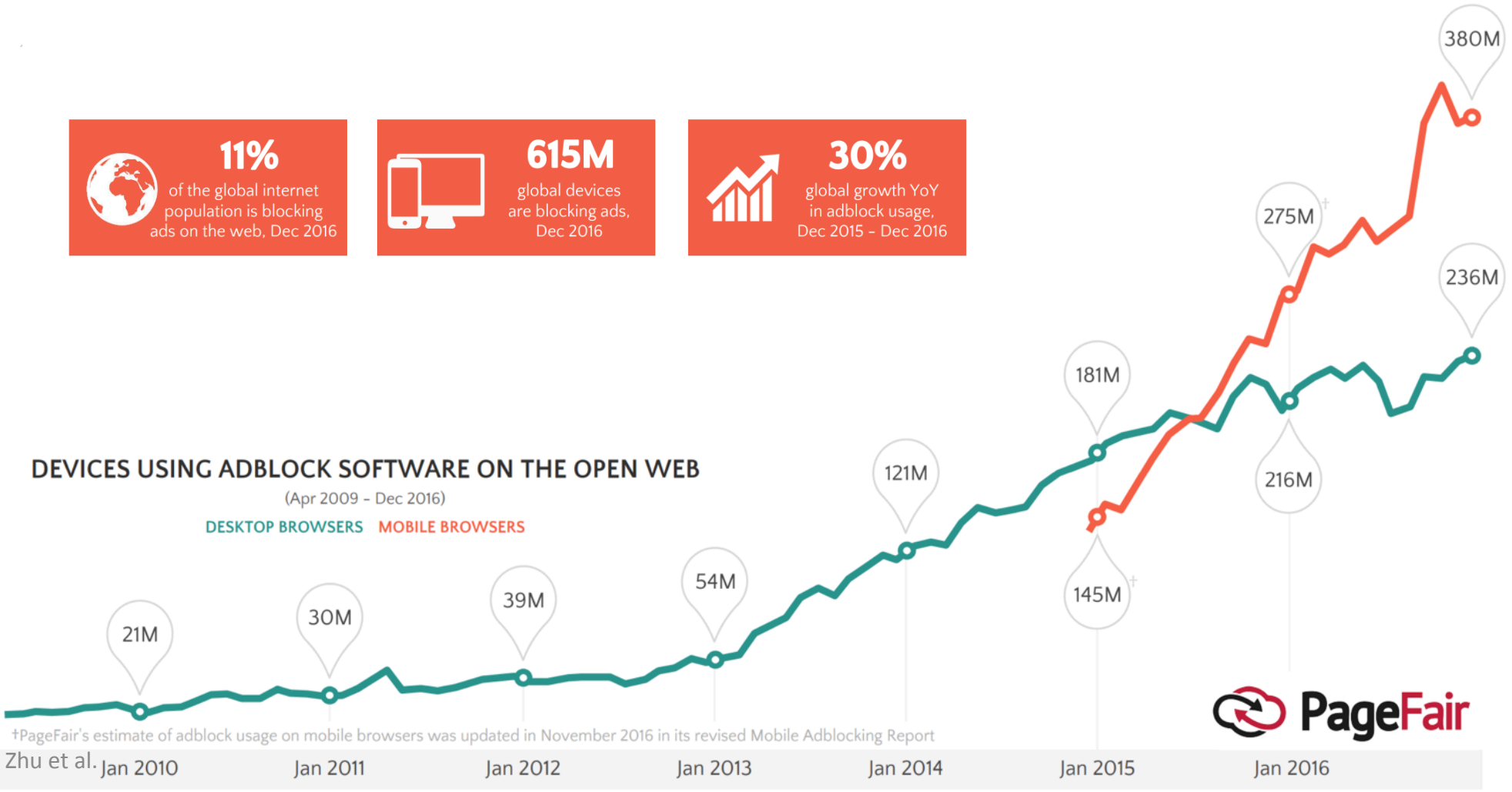
[2] *16 Creepiest Targeted Facebook Ads* http://mashable.com/2014/08/13/facebook-ads-creepy/#kuIr6KVMAaqc

Or Worse, Malvertising

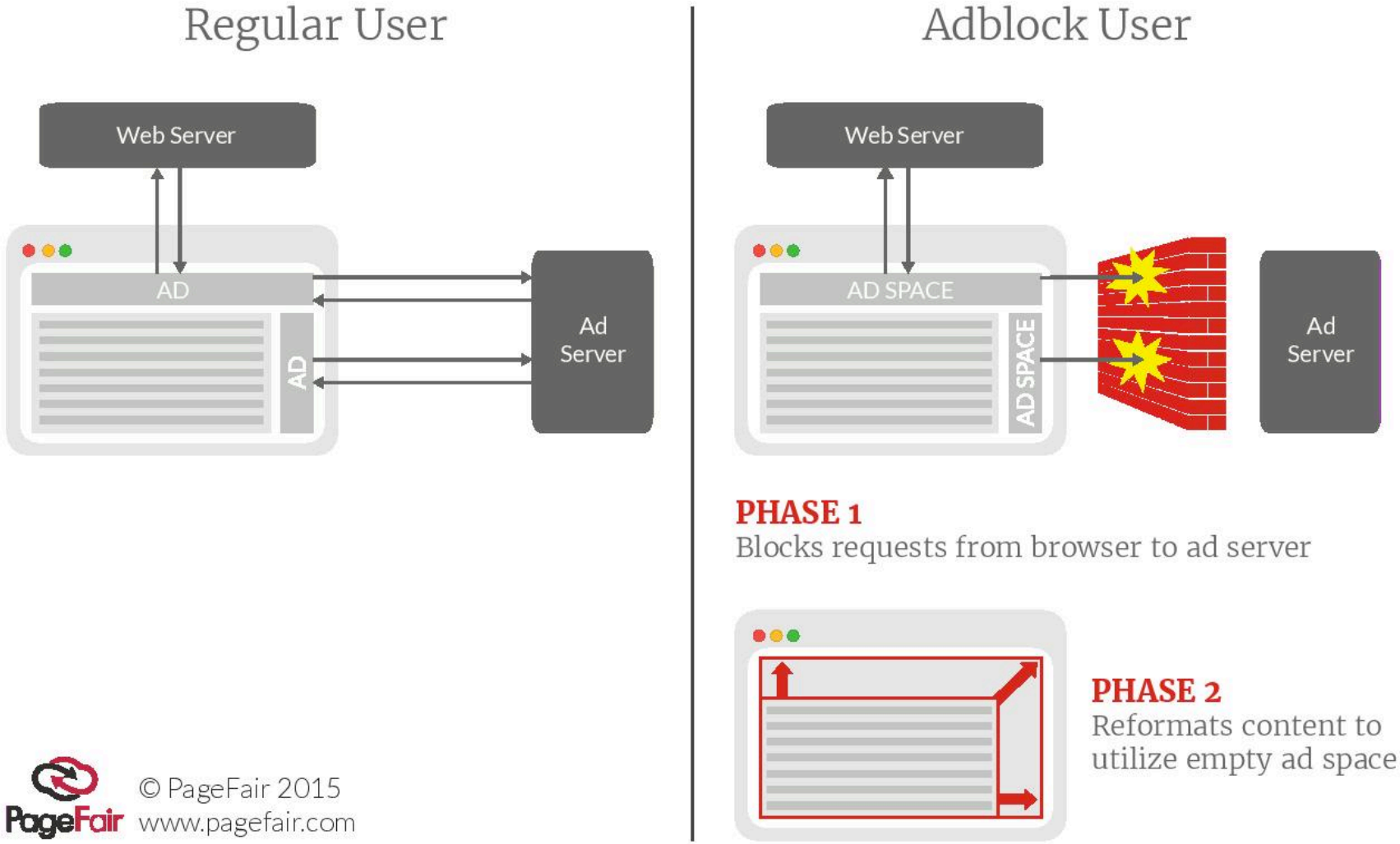


[3] *RoughTed: the anti ad-blocker malvertiser* https://blog.malwarebytes.com/cybercrime/2017/05/roughted-the-anti-ad-blocker-malvertiser/

Ad Blockers To The Rescue!



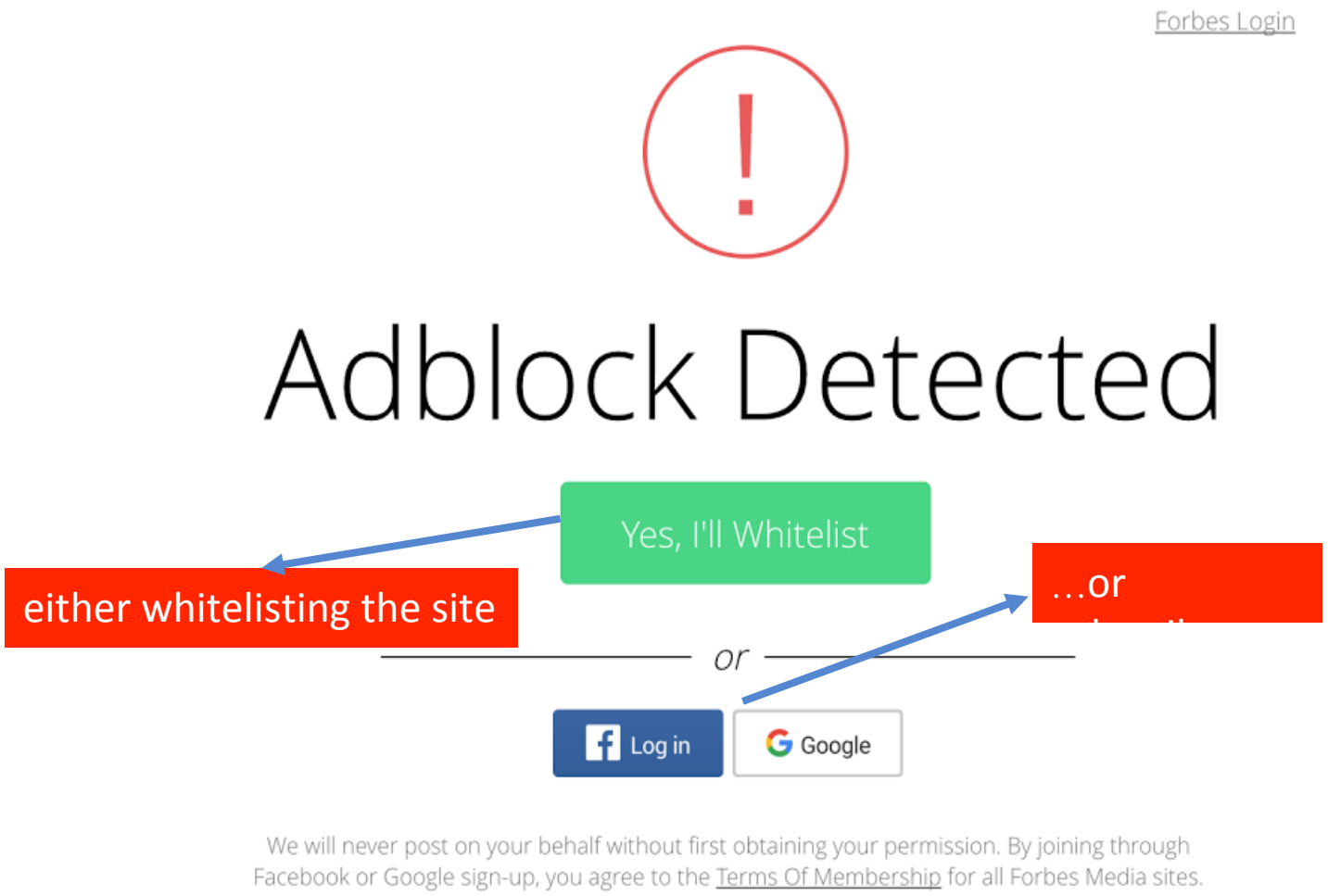
How Ad blocking Works?



What Does Ads Industry Think/React?

- In a word, not happy…
- Considers adblockers a serious threat to their business model
- Their move: deploying **Anti-Adblocker** that
  - (1) **detects** the presence of adblocker,
  - (2) **reacts** to adblocker by:
    - completely/partly blocking the real content
    - issuing warning messages
    - silently reporting adblocking status

What Does Ads Industry Think/React?

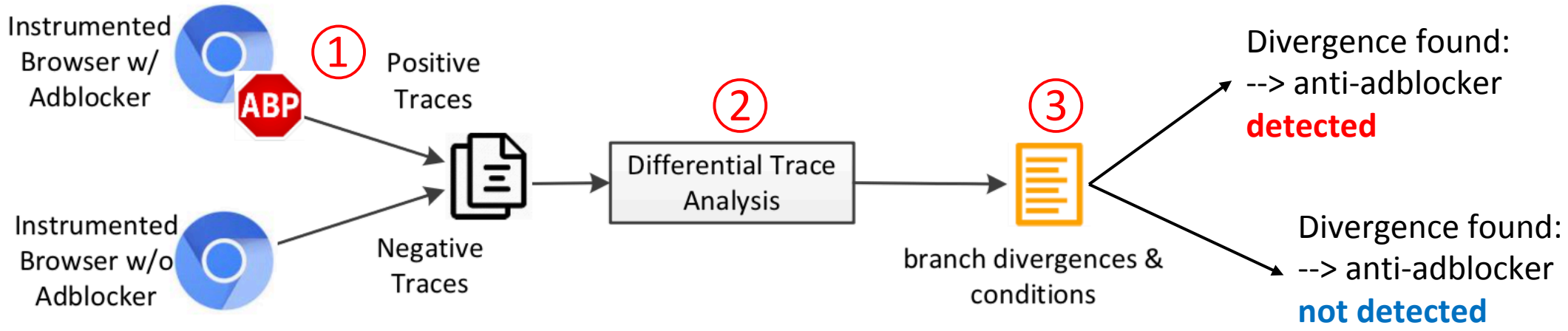


Now, Our Turn?

- Already an escalating arms race, with no winner yet
- Goals:
  1) **we want to investigate the ongoing arms race**
  2) **with this knowledge, we want to escalate this arms race**
- Our prior work:
  - IMC ’17: coverage of the current anti-adblock filter-list is NOT good (only ~9%)
  - PETS ‘17: A/B testing, static analysis (only for visible ones/cannot locate relevant code)
- Our latest move: **differential execution analysis**

Our Idea & System

- Key observation: a website employing anti-adblocker would have a different JavaScript execution trace if it is loaded with adblocker (positive trace) as compared to without adblocker (negative trace)
- System overview:



Differential Execution Analysis? What Is It?

- It's in general a long-awaited program analysis technique, but can be somehow implemented quite straightforward in our case:

```
if (!ad || ad.innerHTML.length == 0 || ad.
    clientHeight === 0)
  alert("We've detected an ad blocker running on
      your browser." + ...);
```

- what will appear in our execution trace when we **enable** adblocker?

```
http://www.example.com/main.js IF 888
http://www.example.com/main.js THEN 888
```

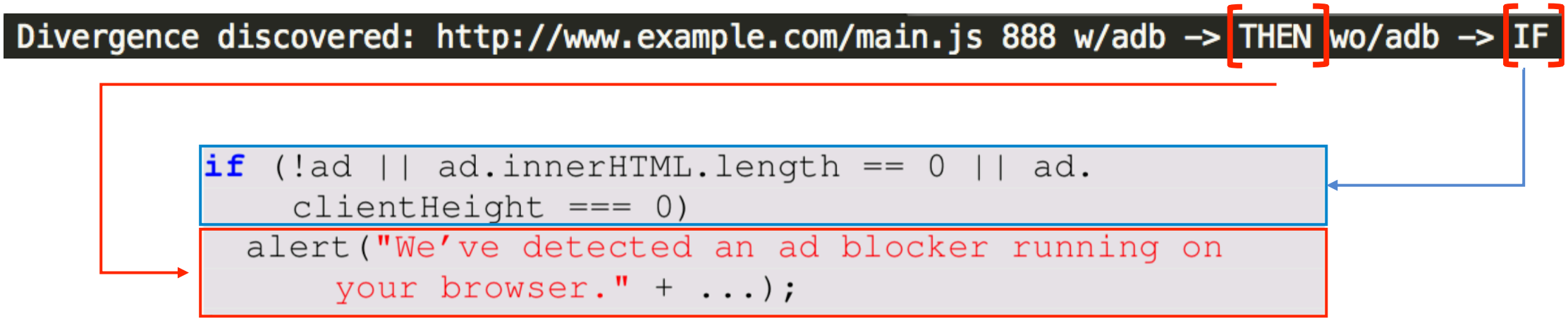
- what will appear in our execution trace when we **disable** it?

```
http://www.example.com/main.js IF 888
```

How Good Is It?

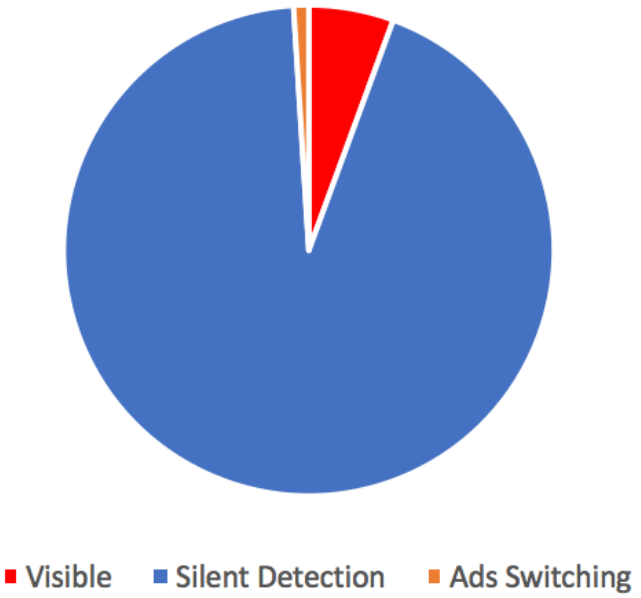
- On ground-truth datasets, our system achieves
  - **True Positive** rate: 86.9% | **False Positive** rate: 0%

- More information beyond the binary results



Large-Scale Analysis In The Wild

- Key finding:
  - we detected anti ad-blockers on **30.5%** of the Alexa top-10K websites which is **5-52** times more than reported in prior literature
- Why such a big gap?
  - remember that a typical anti-adblocker has two components:
    1. ad blocker detection
    2. subsequent reaction **(possibly silent)**



Large-Scale Analysis In The Wild

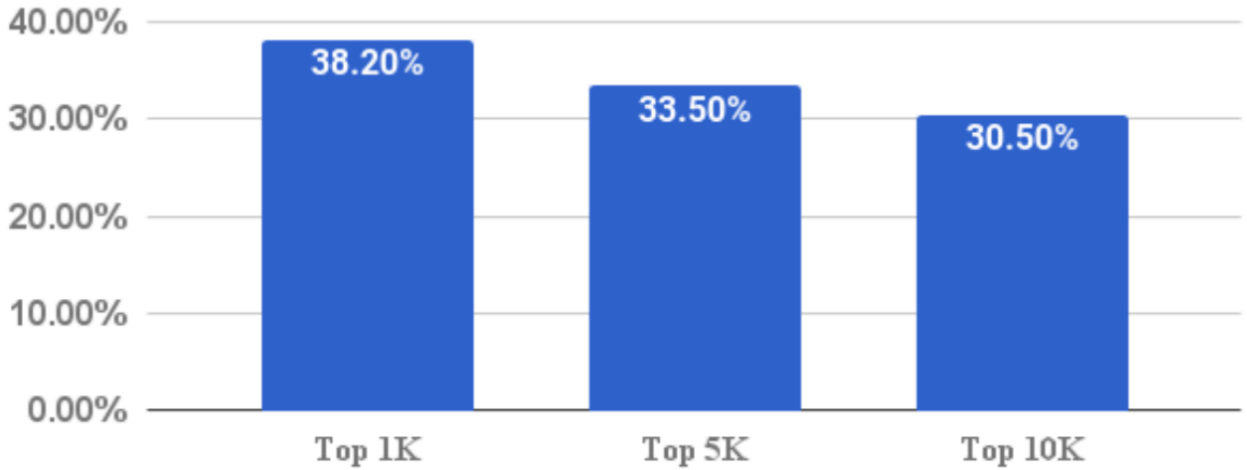
```
1  var blockStatus = 'Unblocked';
2  var ad = $('#adsense')[0];
3  if (!ad || ad.innerHTML.length == 0 || ad.
       clientHeight === 0) blockStatus = 'Blocked';
4  ga('send', 'event', 'Ad block JavaScript',
       blockStatus, 'Desktop', {nonInteraction: true});
5  ga('theLocalNetwork.send', 'event', 'Ad block
       JavaScript', blockStatus, 'Desktop', {
       nonInteraction: true});
```

Other Findings

- Origins of top scripts containing anti-adblocking logic:

DoubleClick by Google, Taboola, Chartbeat, YouTube, PageFair, Yandex, @mail.ru

- Popularity of anti-adblockers by website ranking



Improving Adblockers

- Avoiding Anti-adblockers with JavaScript Rewriting

```
1  if (hasBlock() && matches(StackTrace.getSync(),
       recorded_stacktrace) && false) {
2    $('.notification').show();
3  }
```

- Hiding Adblockers with API Hooking (stealthy adblocker)
  - all API calls used by publisher scripts to examine the state of the page (e.g., whether an ad is visible) can be intercepted and modified by a browser extension

Future

- Users should have the right to make a choice

- Alternative business models
  - Acceptable Ads program & Better Ads standards
  - Ads profit re-distribution: Brave browser

Q & A

- Complementary Material
- https://sites.google.com/view/antiadb-proj