CrowdSurf: Empowering Informed Choices in the Web

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CrowdSurf
Empowering Transparency in the Web

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Introduction
Do you know what you HTTP?
Web tracking

Thousands of Web trackers collect our data:

- Browsing histories
- Religious, sexual, and political preferences
- On average, the first tracker is met as soon as the browser starts
- Some trackers reach 96% of users
- 71% of websites host at least one tracker

The Open Question

How to **know** and **choose** which **services our data is exchanged** with and how?
Partial solutions

In-network devices:
- Firewalls and proxies
  - Fail in case of encrypted traffic (HTTPS)
  - Lack scalability
  - Managed by third parties

On-client:
- Browser plugins
  - Limited scope
  - No control on device traffic
  - Not transparent
A New System

Goal
Let **users** re-gain visibility and **control** on the **information** they exchange with **Web services**

Design Principles

- Holistic
  - working in any scenario
- Client-centric
  - available on any kind of device
- Practical, not revolutionary
  - use existing technology
- Crowd-sourced
  - knowledge built on a community of users
- Automatic
  - little engagement of the user
- Privacy-safe
  - never compromise users’ privacy
CrowdSurf
Cloud

- A **controller** collects information about the services users visit
  - Explicit -> their opinion
  - Implicit -> traffic samples
- Users’ contributions processed by **data-analyzers** and the **advising community**
- Results = **suggestions** about the reputation of services

Client

- Users download the suggestions they like
- the **CrowdSurf Layer** translates them into **rules**
- Rules = **actions** on users’ traffic
  - Regexp + action
CrowdSurf Controllers

Open Controller
- Collaborative approach
- Users improve the wisdom of the system
  - Traffic samples and opinions
  - Build data analyzers and suggestions

Corporate Controller
- Builds directly rules for employees
- Employees can not customize rules
- All devices follow the same rules
The CrowdSurf Layer

- HTTP
- Regular Expression Matching
  - Action: Block, Redirect, Allow, Modify, Log and Report
- Anonymization
- TLS
- TCP

Suggestions to Rules

Open Controller

Corporate Controller
CrowdSurf in a picture

1. Opinions + Traffic samples
2. Suggestions
3. Open Controller
4. Corporate Controller
5. Rules
6. Traffic samples
7. Web Services

Ruled Interaction
Proof of Concept
Prototype

**Controller**
- Java-based web service
- Communicates with CrowdSurf devices
- Hosts a data analyzer for identification of tracking sites
- Collects traffic samples
- Distributes suggestions

**Client**
- Implemented as a Firefox plugin
- Supports block, redirect, log&report
Example of Data Analyzer: Automatic Tracker Detector

Unsupervised methodology to identify third-party trackers [2]

- Observation:
  - trackers usually embed UIDs as URL parameters
- Procedure:
  1. Input: HTTP traffic samples provided by CS users
  2. Take all HTTP queries to third-party services
     http://acmetrack.com/query?key1=X&key2=Y
  3. Extract keys (key1, key2) and their values
  4. Check the presence of key values uniquely associated to the users

Example of Data Analyzer: Automatic Tracker Detector


34 new third-party trackers found
Performance Implications of running CrowdSurf

Different user profiles

**Paranoid Profile**
- Blocks
  - adv/tracking
  - JS code
- Does not report traffic samples

**Kid Profile**
- Activates child protection rules
- Reports traffic to trackers

**Corporate Profile**
- Redirects search.google.com to search.bing.com
- Blocks social networks, e-commerce sites, trackers
- Reports activity on Dropbox
Paranoid is \textbf{1.07} times \textbf{faster} than baseline
Kid is \textbf{1.08} times \textbf{slower}
Corporate is \textbf{1.18} time \textbf{slower}
Conclusion
Open Problems

- Lot of details to consider
- Design/develop/standardize a new network layer
- Protecting users’ privacy
  - Anonymizing HTTP/S traffic
- Usability
- Involve users to join
- Protection from malicious biases
Holistic, crowd-sourced system for the auditing of the information we expose in the Web

https://www.myermes.com
Thank you!
Need a new model that...

Enables transparency and visibility

Takes actions

Under user’s control

Monitor the HTTP traffic *before* encryption takes place

Block/manipulate/report transactions to undesired services

Automatic, but configurable
Example of Data Analyzer: Automatic Tracker Detector

Automatic Tracker Detector vs

Dataset
- HTTP trace from ISP running Tstat
- 10 days of October 2014
- ~19k monitored users
- ~240k HTTP transactions per day

34 new third-party trackers found

<table>
<thead>
<tr>
<th>Third-party Trackers</th>
<th>Keys</th>
<th>New third-party trackers found</th>
</tr>
</thead>
<tbody>
<tr>
<td>atemda.com</td>
<td>bidderuid</td>
<td></td>
</tr>
<tr>
<td>x.bidswitch.net</td>
<td>user_id</td>
<td></td>
</tr>
<tr>
<td><a href="http://www.77tracking.com">www.77tracking.com</a></td>
<td>rand</td>
<td></td>
</tr>
<tr>
<td>rack.movad.net</td>
<td>us</td>
<td></td>
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<tr>
<td>ovo01.webtrekk.net</td>
<td>cs2</td>
<td></td>
</tr>
<tr>
<td>dis.criteo.com</td>
<td>uid</td>
<td></td>
</tr>
<tr>
<td>p.rfihub.com</td>
<td>bk-uuid</td>
<td></td>
</tr>
<tr>
<td>ib.adnxs.com</td>
<td>xid</td>
<td></td>
</tr>
</tbody>
</table>

| Portal1                     | 26                    |
| E-commerce1                 | 13                    |
| E-commerce2                 | 12                    |
| E-commerce3                 | 9                     |
| Portal2                     | 4                     |
| Porn                        | 3                     |
| Sportnews                   | 1                     |
| SearchEngine                | 1                     |
Example
A growing business around our data

Loss of visibility and control

- HTTPS *protects* our privacy, but...
- ...prevents third parties to check *what’s going on under the hood* of encryption
- ...and *severely limits network functions*

“Child protection through the use of Internet Watch Foundation blacklists has become ineffective, *with just 5% of entries still being blocked* when HTTPS is deployed” [2]

Time to collect a dataset

![Graph showing the relationship between service rank and number of visits.](image)
Monitoring the Web

[1] Popa, L. et al., "HTTP As the Narrow Waist of the Future Internet," ACM HotNets, 2010
CrowdSurf Controllers

Open Controller
- Collaborative approach
- Users improve the wisdom of the system
  - Traffic samples and opinions
  - Build data analyzers and suggestions

Third party Controller
- Suggestions for commercial purposes
- Opens to a market of suggestions

Corporate Controller
- Builds directly rules for employees
- Employees can not customize rules
- All devices follow the same rules
CrowdSurf in a picture

- Open controller
- Third-party controller
- Corporate controller
- Web Services

Traffic samples: Corporate Rules, Web Browsing
Suggestions: Private User Device, Corporate Device, Data Analyzer