CrowdSurf: Empowering Informed Choices in the Web

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CrowdSurf
Empowering Transparency in the Web

25 Aug 2016, ACM SIGCOMM, Florianopolis

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Introduction
Do you know what you HTTP?
Example
Web tracking

Thousands of trackers collect our data

- Browsing histories
- Religious, sexual, and political preferences

- On average, the first tracker is met as soon as the browser starts [1]
- Some trackers reach 96% of users [1]
- 71% of websites host at least one tracker [1]

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

- Network devices: Firewalls and proxies fail in case of encrypted traffic (HTTPS), lack scalability, and are managed by third parties.
- Client-side solutions: Browser plugins have limited scope, no control on device traffic, and are not transparent.

Google, Microsoft, and Amazon are paying Adblock Plus huge fees to get their ads unblocked.
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

Suggestions to Rules

Anonymization

TLS

TCP

Open Controller

Corporate Controller
CrowdSurf in a picture

Suggestions

Opinions + Traffic samples

Open Controller

Ruled Interaction

Web Services

Opinions

Suggestions

Traffic samples

Rules

Traffic samples

Ruled Interaction

Corporate Controller
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 \((\text{key1}, \text{key2})\) and their values
  4. Check the presence of key values uniquely associated to the users

Example of Data Analyzer: Automatic Tracker Detector

[Diagram showing 3 visits with different identifiers in sid, tmp, and uid columns. Each row shows unique combinations.]

Visit 1 | Visit 2 | Visit 3
---|---|---
sid | a | b | c | d | e | f | g | h | i
tmp | m | m | m | m | n | n | n | n | p | p | p | p
uid | x | y | z | x | y | z | x | y | z


*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 1.07 times faster than baseline
Kid is 1.08 times slower
Corporate is 1.18 time 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
CrowdSurf

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
  - Monitor the HTTP traffic before encryption takes place
  - Block/manipulate/report transactions to undesired services
- Takes actions
- Under user’s control
  - 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

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26 August 2016   CrowdSurf - Stefano Traverso
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 over time](image)

- **Number of Visits**
- **Service Rank**
- **$T_c$**

*googleanalytics*
Monitoring the Web

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

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