# A Privacy Threat Observatory

Dr. Vasileios Vlachos (CTI)


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**Privacy Flag Project** Enabling Crowd-sourcing based privacy protection for smartphone applications, websites and Internet of Things deployments

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# About CTI

- One of the major R&D institutes in Greece
- Has undertaken more than 85 R&D projects
- The team involved in Privacy Flag works within CTI's Research Unit 1 (RU1) which consists of 7 Faculty Members, 9 PhD Researchers and 20 Engineers-PhD Students
- The CTI team is involved in relevant FP7 and national projects in the privacy/security, crowdsensing/crowdsourcing and IoT (PROTOS, ABC4Trust, IoT Lab)

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# ~~Diamonds~~ Data are fover

Third party tracker or advertising company


Cookies

Fingerprinting

Traffic analysis

PrivacyFlag AddOn User


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# Smartphone Privacy Invasion in action

**Source https://www.hackread.com/flashlight-apps-stealing-your-personal-information/**

| Flashlight Apps |  Super-Bright LED Flashlight |  Brightest Flashlight Free |  Tiny Flashlight + LED |  Flashlight |  Flashlight |  Brightest LED Flashlight |  Color Flashlight |  High-Powered Flashlight |  Flashlight HD LED |  Flashlight: LED Torch Light |
|---|---|---|---|---|---|---|---|---|---|---|
| **Permissions** | | | | | | | | | | |
| retrieve running apps | ✓ | | | | | ✓ | | ✓ | | |
| modify or delete the contents of your USB storage | ✓ | ✓ | | | | ✓ | | ✓ | | |
| test access to protected storage | ✓ | ✓ | | | | ✓ | | ✓ | | |
| take pictures and videos | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| view Wi-Fi connections | ✓ | ✓ | | | | ✓ | | ✓ | ✓ | |
| read phone status and identity | ✓ | ✓ | | | ✓ | ✓ | | ✓ | | |
| receive data from Internet | ✓ | | | | | ✓ | | ✓ | | |
| control flashlight | ✓ | ✓ | ✓ | | | ✓ | ✓ | ✓ | ✓ | |
| change system display settings | ✓ | | | | | ✓ | | ✓ | | |
| modify system settings | ✓ | | | | | ✓ | | ✓ | | |
| prevent device from sleeping | ✓ | | | | | | | ✓ | | |
| view network connections | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| full network access | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| approximate location (network-based) | ✓ | ✓ | | | | | | ✓ | | |
| precise location (GPS and network-based) | ✓ | ✓ | | | | | | ✓ | | |
| disable or modify status bar | ✓ | ✓ | | | | | | | | |
| read Home settings and shortcuts | ✓ | ✓ | | ✓ | | | | | | ✓ |
| install shortcuts | ✓ | ✓ | | ✓ | | | | | | ✓ |
| uninstall shortcuts | ✓ | ✓ | | ✓ | | | | | | ✓ |
| control vibration | ✓ | | ✓ | | | | | | | |
| prevent device from sleeping | | ✓ | ✓ | ✓ | | ✓ | | | ✓ | ✓ |
| write Home settings and shortcuts | | | | ✓ | | | | | | ✓ |
| disable your screen lock | | | | ✓ | | | | | | ✓ |
| read Google service configuration | | | | | ✓ | | | | ✓ | |

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# IoT Privacy?

- "Internet of things" becomes part of our life
  - ❖ Animate and inanimate will be interconnected
  - ❖ Unique identification between each other
- Billion devices are connected already
- More and more devices will be connected in the near future
- The more the devices the largest the **ATTACK** surface

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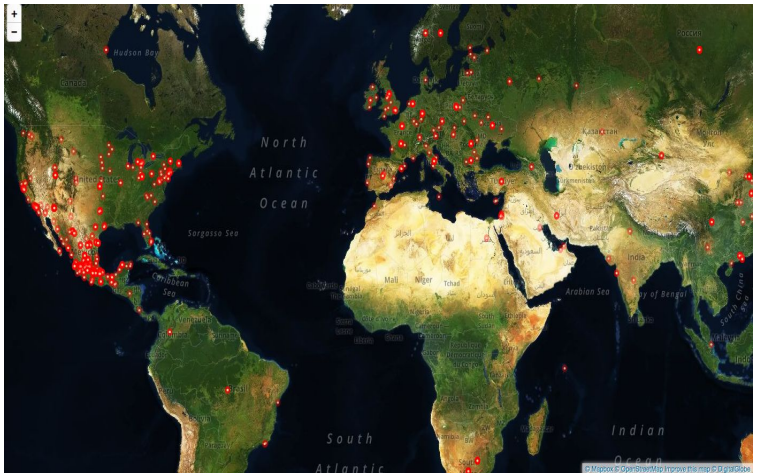
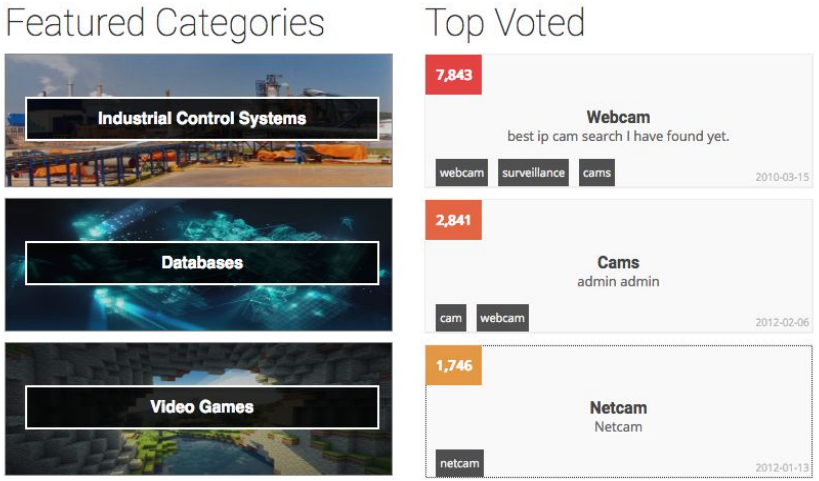
# IoT Security

## All your IoT devices (routers, ip cameras, smart-home devices etc) belong to… hackers





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# IoT Security

## Meet the “Mirai” IoT Botnet

[FREE] World's Largest Net:Mirai Botnet, Client, Echo Loader, CNC source code release

Yesterday, 12:50 PM (This post was last modified: Yesterday 04:29 PM by Anna-senpai.)

Anna-senpai

L33t Member

L33T

Preface

Greetz everybody,

When I first go in DDoS industry, I wasn't planning on staying in it long. I made my money, there's lots of eyes looking at IOT now, so it
However, I know every skid and their mama, it's their wet dream to have something besides qbot.

So today, I have an amazing release for you. With Mirai, I usually pull max 380k bots from telnet alone. However, after the Kreb DDoS,
shutting down and cleaning up their act. Today, max pull is about 300k bots, and dropping.

So, I am your senpai, and I will treat you real nice, my hf-chan.

Source KrebsOnLine:https://krebsonsecurity.com/2016/10/source-code-for-iot-botnet-mirai-released/

**Bashlight + Mirai botnets > 1.400.000 bots**

# @620 Gbps DDoS

Previous max: 363 Gbs DDoS

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# Web Privacy Invasion in action

**Device fingerprinting** is the capability of a site to identify a visiting user via configuration settings or other observable characteristics. In the "ideal" case, all web client machines would have a different fingerprint value (diversity), and that value would never change (stability). Panopticlick demonstrates the kind of information obtained:


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# Browsers: The weak link in Web Privacy

Browserscope is a community-driven project for profiling web browsers. The goals are to foster innovation by tracking browser functionality and to be a resource for web developers.

Top Browsers

| name | score | postMessage | JSON.parse | toStaticHTML | httpOnly cookies | X-Frame-Options | X-Content-Type-Options | Block reflected XSS | Block location spoofing | Block JSON hijacking | Block XSS in CSS | Sandbox attribute | Origin header | Strict Transport Security | Block cross-origin CSS attacks | Cross Origin Resource Sharing | Block visited link sniffing | Content Security Policy | # Tests |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Chrome 32 → | 15/17 | yes | yes | no | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | no | 797 |
| Firefox 26 → | 13/17 | yes | yes | no | yes | yes | no | no | yes | yes | yes | yes | no | yes | yes | yes | yes | yes | 873 |
| IE 9 → | 13/17 | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | no | no | no | yes | yes | yes | no | 3640 |
| IE 10 → | 14/17 | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | no | no | yes | yes | yes | no | 1291 |
| IE 11 → | 14/17 | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | no | no | yes | yes | yes | no | 2325 |
| Safari 7.0.1 → | 14/17 | yes | yes | no | yes | yes | no | yes | yes | yes | yes | yes | yes | no | yes | yes | yes | yes | 57 |
| Chrome 34 → | 16/17 | yes | yes | no | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | 793 |
| Firefox 27 → | 13/17 | yes | yes | no | yes | yes | no | no | yes | yes | yes | yes | no | yes | yes | yes | yes | yes | 604 |
| Android 2.3 → | 10/17 | yes | yes | no | no | yes | no | no | yes | yes | yes | yes | yes | no | yes | yes | no | no | 494 |
| Android 4 → | 12/17 | yes | yes | no | yes | yes | no | no | yes | yes | yes | yes | yes | no | yes | yes | yes | no | 1415 |
| Blackberry 7 → | 13/17 | yes | yes | no | yes | yes | no | no | yes | yes | yes | yes | yes | yes | yes | yes | yes | no | 26 |
| Chrome Mobile 18 → | 16/17 | yes | yes | no | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | 58 |
| IEMobile 9 → | 13/17 | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | no | no | no | yes | yes | yes | no | 33 |
| IEMobile 10 → | | | | | | | | | | | | | | | | | | | 0 |
| iPhone 7 → | | | | | | | | | | | | | | | | | | | 0 |

Compare Browsers

We think you're using Chrome 46.0.2490 12406 tests from 15 browsers Downloads: json pickle csv Link to this page

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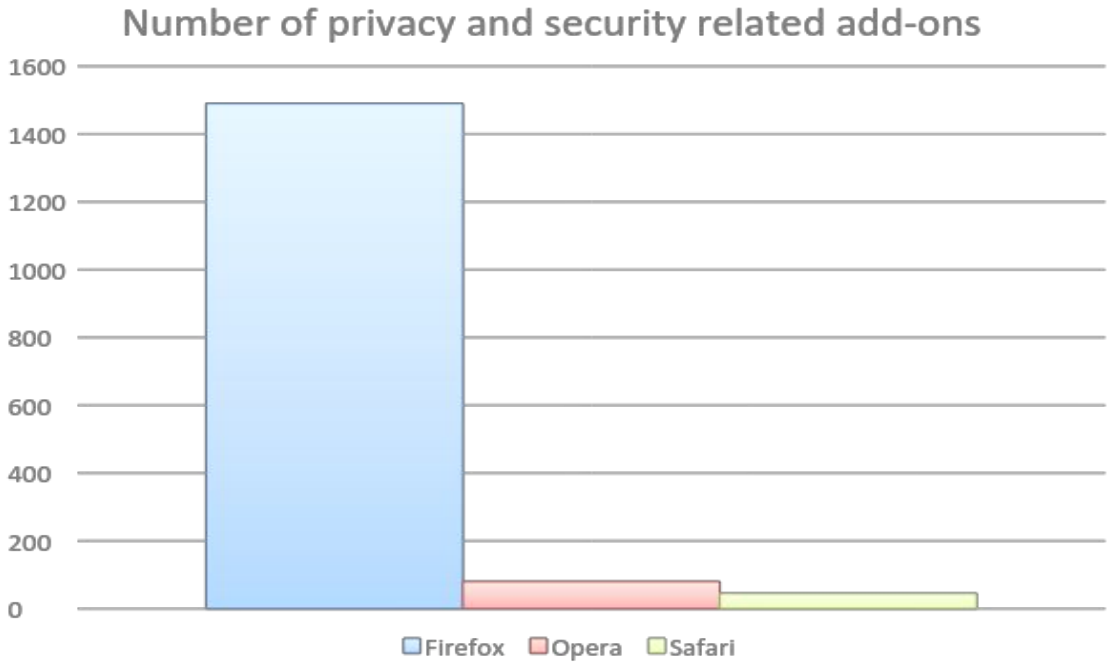
# Browsers: The weak link in Web Privacy




There are no available data for Google's Chrome browser, but the number of add-ons is comparable to that of Mozilla's Firefox.

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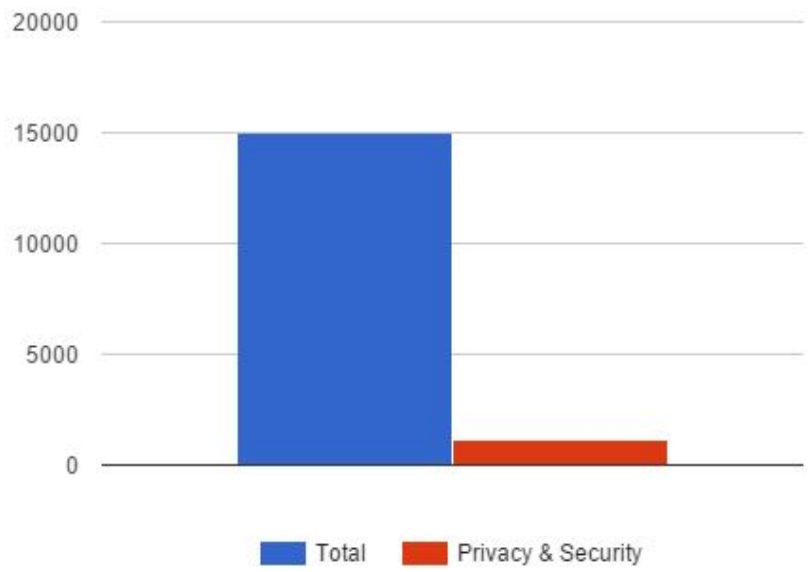
# Browsers: The weak link in Web Privacy




Number of Privacy and security enabled addons compared to the total number of addons available for Mozilla Firefox

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# Browsers: The weak link in Web Privacy

## All modern browsers have a “Do not track” option

**Chrome**

- Has discrete privacy settings
- Google stores a lot of information on their servers but none of it is used to identify users according to google
- There is no clear indication for the duration these data are stored.

**Firefox**

- Clearly explains in their privacy policy what information is collected based on the features used.
- All of the information sent is opt-in, not opt-out, and none of it is personally identifiable
- The privacy policy also includes information about what Mozilla shares with third parties upon request.

**Other browsers:**

- Opera collects very little information and all of it is stored as aggregate
- Apple has a global privacy policy, as well as a commitment to customer privacy
- Internet explorer has different privacy policies with each new version

**Bottomline:** Firefox is the most privacy enabled browser, with a clear privacy policy. But, in essence all browsers are similar regarding privacy issues.

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# Browsers: The weak link in Web Privacy

Several add-ons are available for modern browsers such as:

**Privacy Badger:** Stops advertisers and other third-party trackers from secretly tracking users without their permission. Privacy Badger automatically blocks such advertisers from loading content on the user's browser.

**Adblock Plus:** It allows users to prevent page elements, such as advertisements, from being downloaded and displayed. Can block tracking, malware domains, banners, pop-ups and video ads. Unobtrusive ads aren't being blocked in order to support websites

**Click&Clean:** Can protect user privacy by cleaning up all traces of their internet activity by erasing temporary files, cookies, emptying cache, removing Flash Cookies (LSOs) and more.

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# Privacy Challenges

- None of the above solutions provides a holistic approach (web, mobile, IoT)
- Techno-legal challenges
- Technical vs Human solution


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# About PrivacyFlag

## MAIN GOALS OF THE PROJECT

Privacy Flag is developping a highly scalable privacy monitoring and protection solution with:

- Crowdsourcing mechanisms to identify, monitor and assess privacy-related risks;
- Privacy monitoring agents to identify suspicious activities and applications;
- Universal Privacy Risk Area Assessment Tool and methodology tailored on European norms on personal data protection;
- Personal Data Valuation mechanism;
- Privacy enablers against traffic monitoring and finger printing;
- User friendly interface informing on the privacy risks when using an application or website.

Privacy Flag is building a global knowledge database of identified privacy risks, together with online services to support companies and other stakeholders in becoming privacy-friendly, including:

- In-depth privacy risk analytical tool and services;
- Voluntary legally binding mechanism for companies located outside Europe to align with and abide to European standards in terms of personal data protection;
- Services for companies interested in being privacy friendly;
- Researching the potential for standardization, labelling and certification.

Privacy Flag will work in close interaction with standardization bodies and will actively disseminate towards the public and specialized communities, such as ICT lawyers, policy makers and academics.

11 European partners, including SMEs and a large telco operator, bring their complementary technical, legal, societal and business expertise; strong links with standardization bodies and international fora; and outcomes from over 20 related research projects. It intends to pave the way to a privacy defenders community .

News

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# What is crowdsourcing?

- **Crowdsourcing** characterizes large scale experimental set-ups which engage large numbers of individuals.
- Using internet enabled devices, they interact with specialized information systems that collect and process information.

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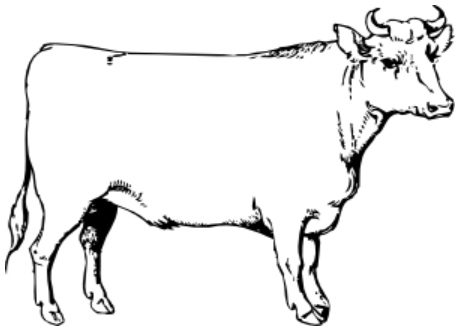
# Advantages of crowdsourcing

- Mobilizes large crowds of people who **volunteer** to contribute towards the collection of environmental data and information or their behavior itself.
- The experimenters can derive **useful global information** about the evolution of a physical phenomenon or explain an observed macroscopic behavior of the crowd population itself
- Collecting data from a large number of individuals leads to **accurate intelligence**.
- **Example:** 800 people estimated the weight of a slaughtered and dressed ox, with 99% accuracy of the true weight.



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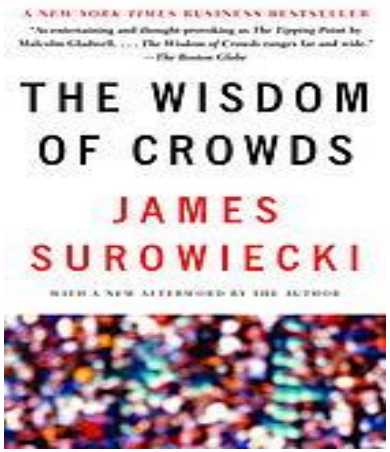
# Crowdsourcing Issues

- For people to be willing to engage in the crowdsourcing scheme they need to **trust** the crowdsourcing authority.
- Individuals can be offered diverse **incentives** (monetary or other) to compensate for their participation and the use of their mobile phones and other devices
- **Machine learning** and other techniques can be used to process the individuals' data and extract useful information

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# Crowdsourcing - How it can help PrivacyFlag

- Collect and process few bits of information from a large number of systems (crowdsourcing) rather than a vast amount of data from a limited number of systems (traditional approach)
- The sum of the PrivacyFlag  manual and automatic analysis is the crowdsourced decision
- The more users , the better the accuracy



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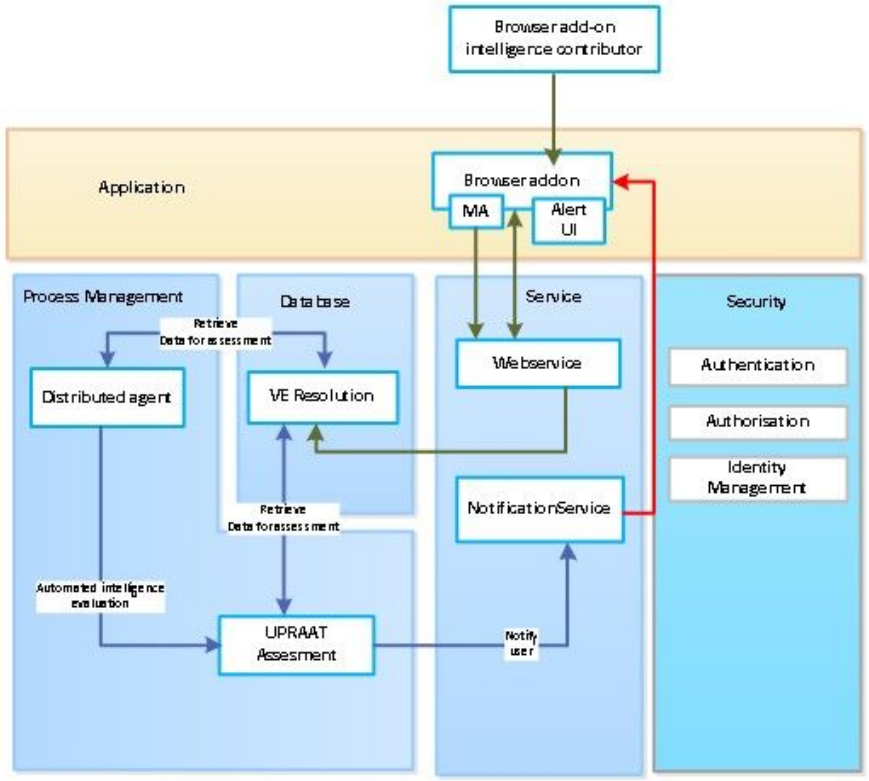
# The Privacy Flag Early Warning System in 10 Steps

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# Step 1: Identify Threats

## The Top25 Web Privacy Threat Matrix

| | The problem to address | Output |
|---|---|---|
| 1 | Does the website provide data encryption (SSL/TLS)? | True / False |
| 2 | Does the website provide HSTS? | True / False |
| 3 | Is the encryption method (cipher suite) negotiated between client and server considered as secure? | True / False |
| 4 | What information does the website/server directly learn about a user (using forms)? | submitted information |
| 5 | Does the website use a trustworthy certification chain? | True / False |
| 6 | Does the website use Certificate pinning? | True / False |
| 7 | Which communication parties is data transferred to? | list of parties |
| 8 | Does the website use HTTP cookies? | [0…n] |
| 9 | Does the website use Third party cookies? | [0…n] |
| 10 | Does the site exploits users Web history? | True / False |
| 11 | Does the website use HTML5 Web SQL database | True / False |
| 12 | Does the website use LSOs? | [0…n] |
| 13 | Does the website use Supercookies? | [0…n] |
| 14 | Does the website use technologies with known security issues - PDF? | True / False |
| 15 | Does the website use known fingerprinting techniques? | [0…n] |
| 16 | Does the website use technologies with known security issues - Flash? | True / False |
| 17 | Does the website contain links to malicious sites (Google's Safe browsing API)? | [0…n] |
| 18 | Does the website use potentially dangerous advanced HTML5 APIs: Web Audio API? | True / False |
| 19 | Does the website use potentially dangerous advanced HTML5 APIs: WebRTC? | True / False |
| 20 | Does the website use potentially dangerous advanced HTML5 APIs: Geolocation (GPS)? | True / False |
| 21 | Does the website use technologies with known security issues - ActiveX? | True / False |
| 22 | Does the website use technologies with known security issues - Java? | True / False |
| 23 | Does the website use technologies with known security issues - Silverlight? | True / False |
| 24 | Does the website use HTML5 Local Storage? | True / False |
| 25 | Does the website comply with any known privacy policy eTrust, P3P, published privacy policy? | True / False |

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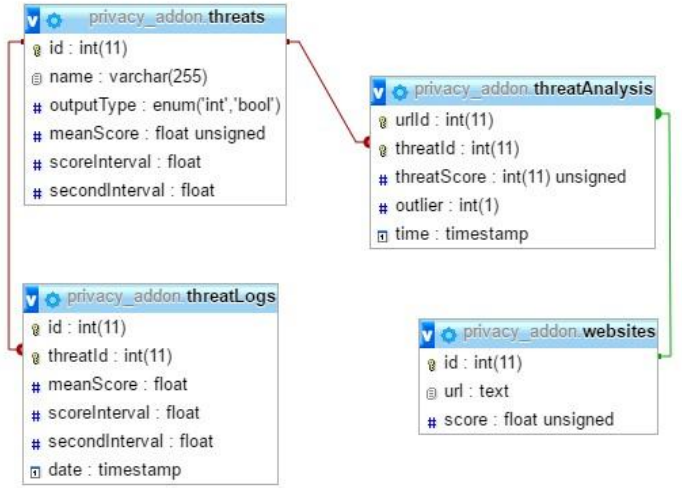
# Step 2: Design

The Top25Threat Matrix has been schematized to provide input to the Evaluation Component regarding Web Privacy Threats

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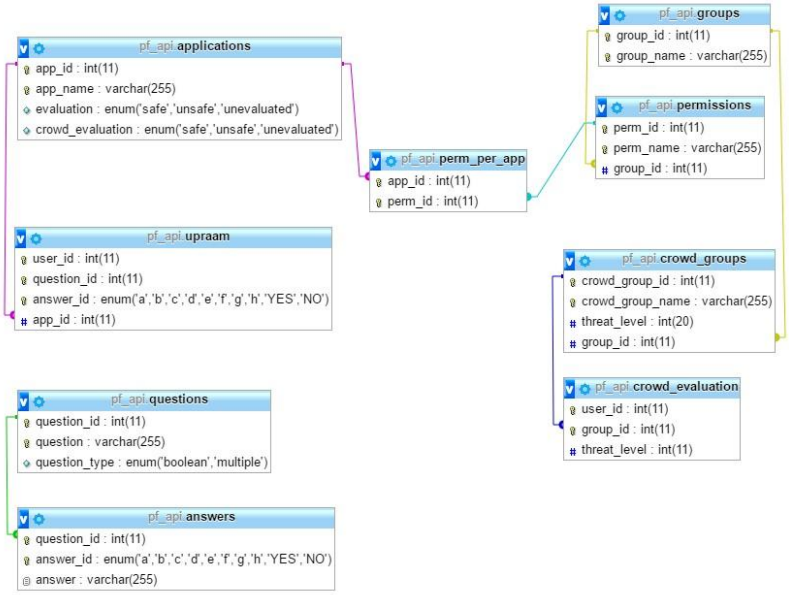
# Step 2: Design

Smart Phone Applications permissions analysis challenge.

DataBase Storage Model finalized and implemented.



Figure 4.3: First version of the Privacy flag application

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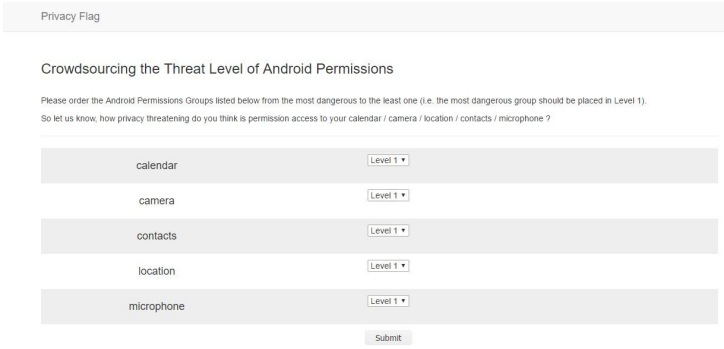
# Step 3: Prioritize
# PrivacyFlag Smart Scoring System




- Crowdsourcing: Let the users choose what is (privacy-related) important based on the Borda counting system
- Different privacy perspective of a businessman (my contacts) than of a teenager (my photos and sms)

http://150.140.193.133:2080/privacy/crowd/

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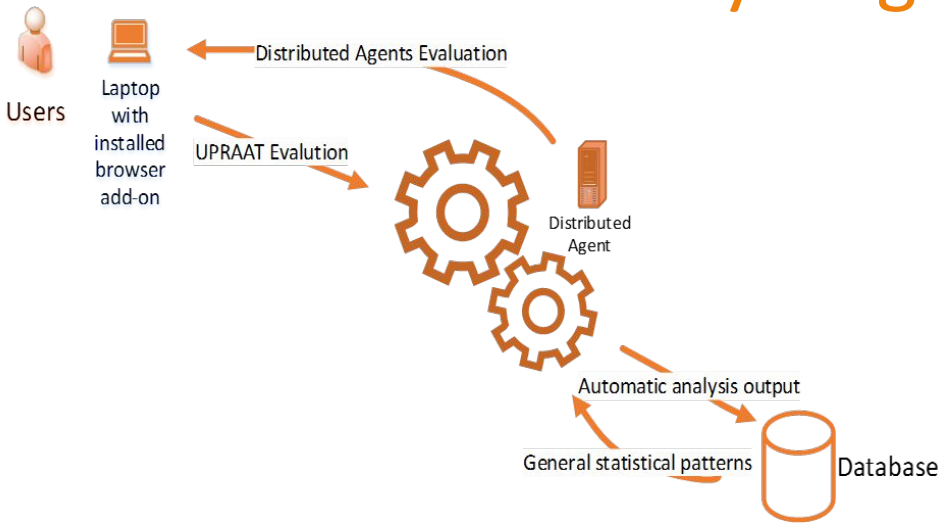
# Step 4: Analyze
# The Privacy Flag Workflow (I)




**Step 1:** The browser add-on analyses the web site that the user is currently on. It calculates a Local Threat Level Score for each threat factor.

**Step 2:** The browser add-on submits in JSON format the Threat Level Score of all Threat Factors to the Distributed Agent and the database.

**Step 3:** (independent - optional):

Crowdsourcing Evaluation Tool experts evaluate manually the web site and submit their evaluation (Local Crowdsourcing Evaluation Tool Score) to the database.

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# Step 4: Analyze
# The Privacy Flag Workflow (II)

**Step 4:** (independent - out of order): The database performs various calculations based on Artificial Intelligence and Machine Learning algorithms and employs advanced statistical and epidemiological models to detect outliers which indicate possible data leakage. The outputs of the database are the **Mean Threat Level Score** and the **Mean Crowdsourcing Evaluation Tool Score.**

**Step 5:** The Distributed Agent queries the database for Crowdsourcing Evaluation Tool scores of the specific site and (if existent) the Mean Threat Level Score and the Mean Crowdsourcing Evaluation Tool Score.

**Step 6:** DA decides based on

- The browser add-on Local Threat Level Score
- The Local Crowdsourcing Evaluation Tool Score
- Mean Threat Level Score
- Mean Crowdsourcing Evaluation Tool Score.

The **final result** of the analysis on the website is presented to the user using color-coded threat level based on how website is categorized, i.e. green color if website is safe or red if there is possible data leakage exposure.

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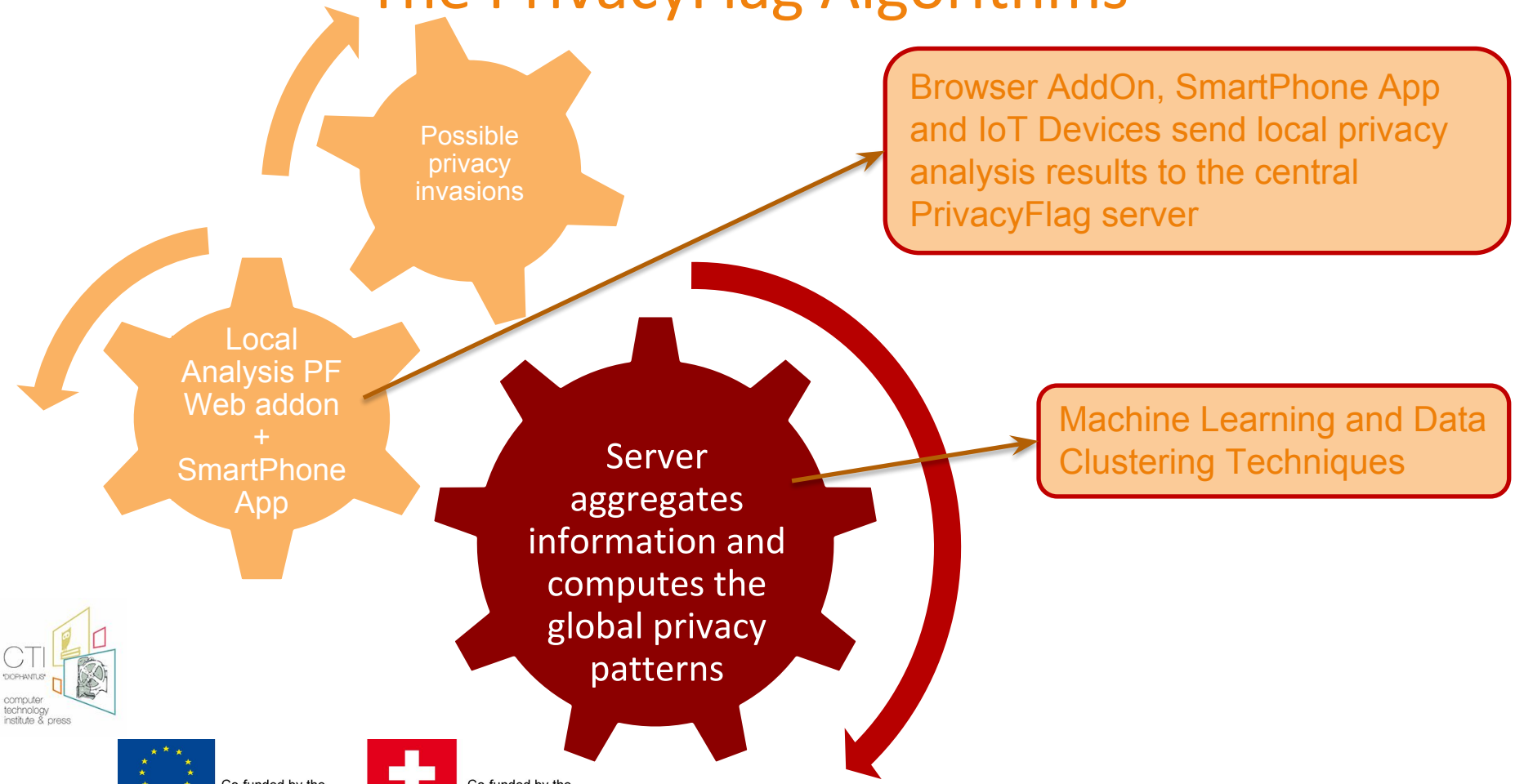
# Step 5: Evaluate The PrivacyFlag Algorithms





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# Step 5: Evaluate

## State of the Art Data Mining:

- **Machine Learning and Epidemic modeling - under heavy development**
  - ❖ Peirce criterion and Euclidean distance → to detect outliers
  - ❖ Epidemic Curves → for malware links and possible for other high risk threats

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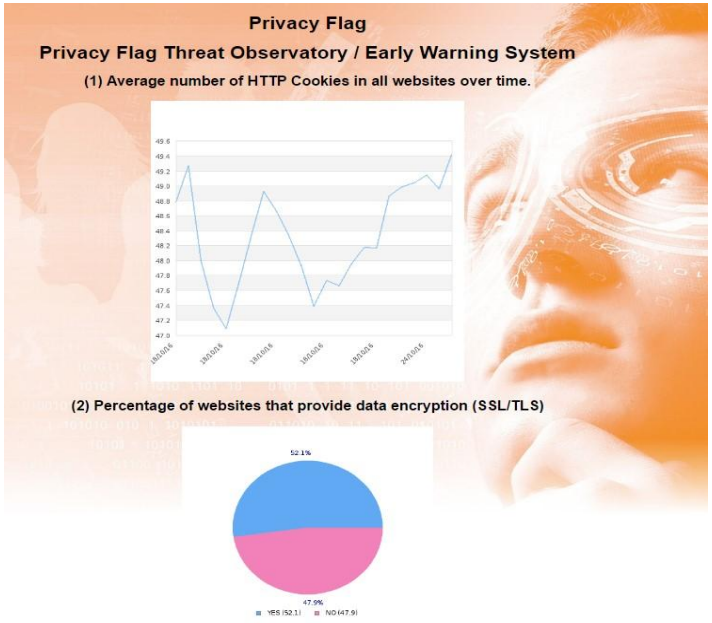
# Step 6: Visualize
# PrivacyFlag Threat Observatory

Get the hole picture!




http://150.140.193.133:2080/privacy/addon/metrics.php

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# Step 7: Scale

- Server Information
  - **OS:** Ubuntu 14.04 LTS
  - **Database:** MySQL
  - **HTTP Server:** Apache2

- API implementation
  - **Javascript with Node.js:** v6.2.1 (https://nodejs.org/)
  - **PHP** v5.5.9
  - **HTML5** and **CSS3**

- API documentation and demonstration
  - **Swagger** Framework (http://swagger.io/)

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# Step 8: Interconnect and Extend

## Privacy Flag API

This is a documentation of the Privacy Flag API. The API is accessible through the following address: http://150.140.193.133:3000

### Smartphone App : Accessing the database through the smartphone App

Show/Hide | List Operations | Expand Operations

| | | |
|---|---|---|
| GET | /smartphone/application | GET existing applications |
| POST | /smartphone/application | POST new applications to the database |
| GET | /smartphone/application/{appName} | GET a specific application |
| GET | /smartphone/permission | GET existing permissions |
| GET | /smartphone/permission/{permName} | GET a specific permission |
| GET | /smartphone/group | GET existing Permission groups |
| GET | /smartphone/group/{groupName} | GET a specific Permission group |

### Browser Addon : Accessing the database through the browser addon

Show/Hide | List Operations | Expand Operations

| | | |
|---|---|---|
| GET | /addon/website | GET information about all the websites stored in the database |
| GET | /addon/website/{siteParam} | GET information about a specific website stored in the database |
| GET | /addon/threat | GET information about all the threats from the top 25 matrix |
| GET | /addon/threat/{threatParam} | GET information about a specific threat from the top 25 matrix |

[ BASE URL: / , API VERSION: 0.0.1 ]

Swagger

**http://150.140.193.133:2080/privacy/docs/**

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PRIVACY FLAG

# Step 9: Wrap it up!

- The number of privacy threats is increasing rapidly as more people use smart devices.
- It is of paramount importance to empower users to protect their privacy.
- **Privacy Flag** presents a novel view on privacy protection of users in their daily interactions with the Internet based on the crowd sourcing paradigm. The project's output will be a **distributed and crowd-sourced monitoring framework** able to provide a collective protection framework combined with increased user privacy awareness which, as an important consequence, is expected to exert pressure on ICT companies to improve their privacy compliance and privacy protection mechanisms.

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# Step 10: Your questions!


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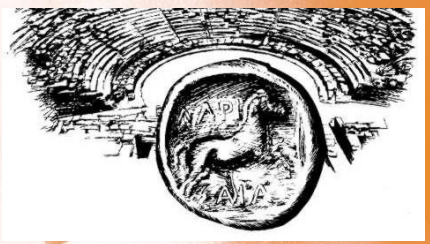

Download: http://protos.cti.gr/


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