Current Investigation
Toward a Security Reference Architecture of Web Browser

Paulina Silva Ghio

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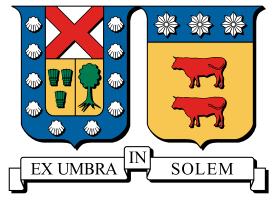
22-03-2016/23-03-2016.



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Context

- Web Browser's war in the nineties.
- Built and fix.
- Web Browser: a tool used daily.
- Common user uses its services.
- Many type of implementations.
- Web 2.0 y 3.0: AJAX (Asynchronous Javascript and XML).

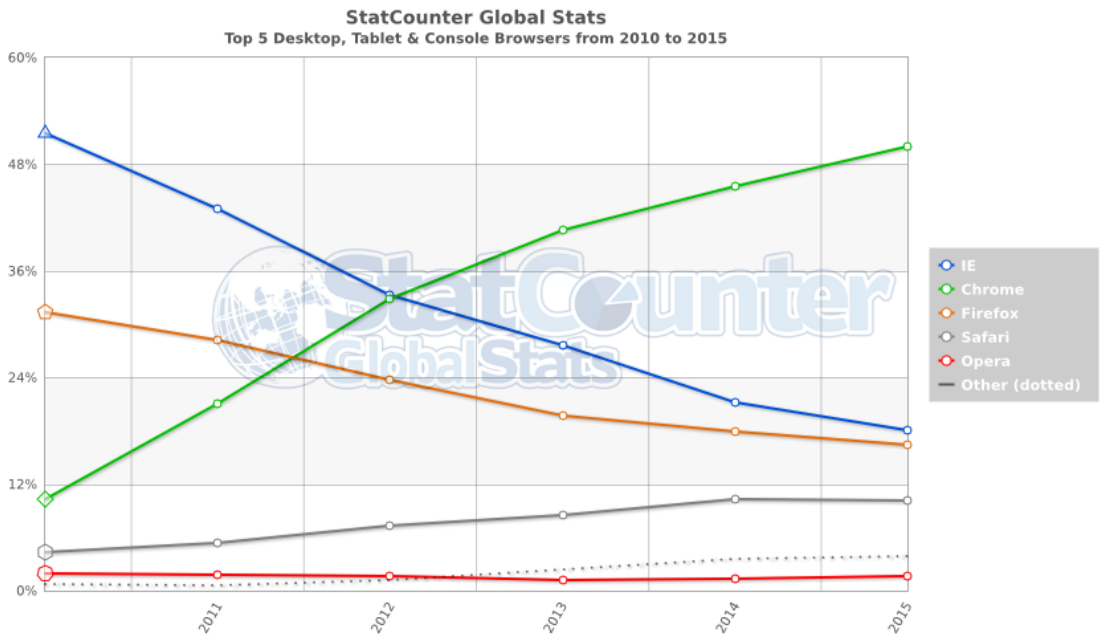

Figura: Market Percentaje of each Browser. Cite: [1]

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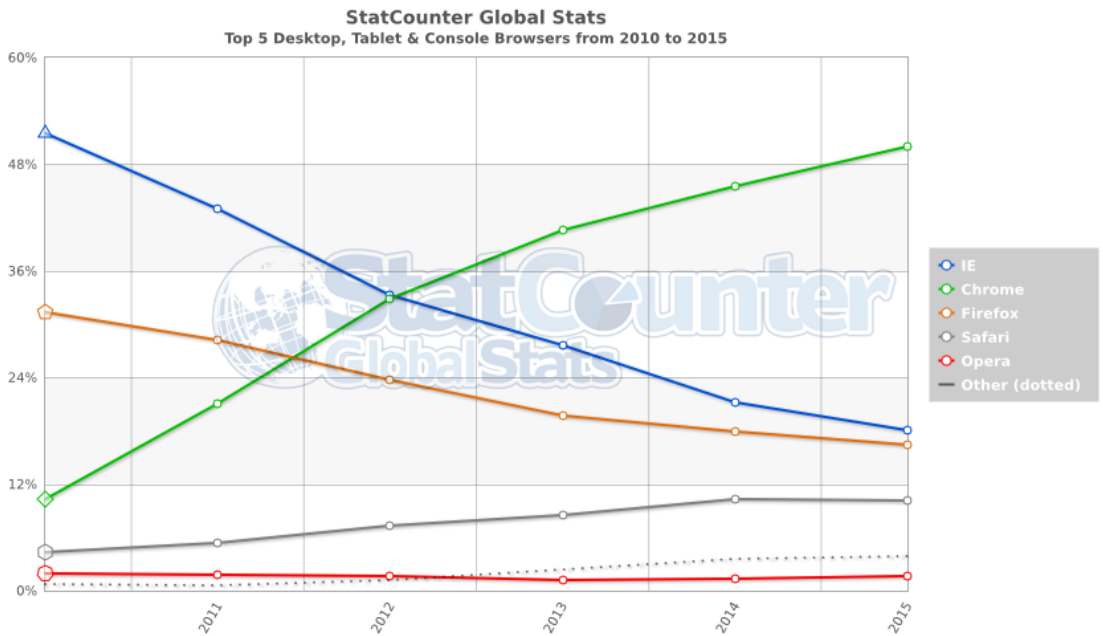

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Motivation

Browser is an indispensable tool, this lets:

- New ways of interacting.
- Lower building costs for a client program.
- Already implemented a lot of robust security features in the browser.
- Reuse.

Principal Concerns

- Systems which are called by users using a browser.
- Stakeholders involved: browser's user, host's user and the external service used.

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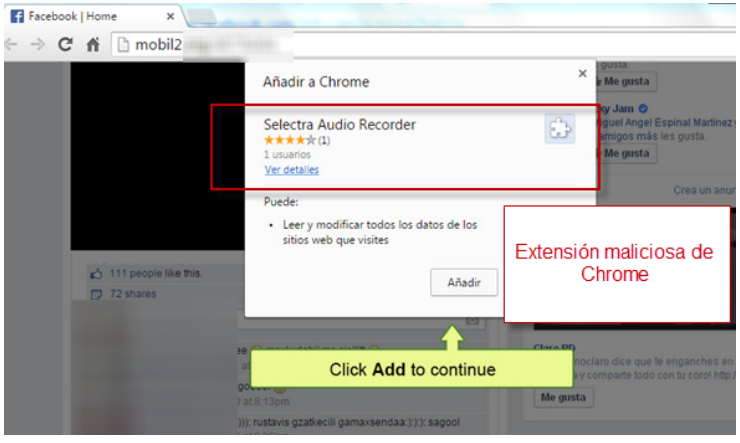
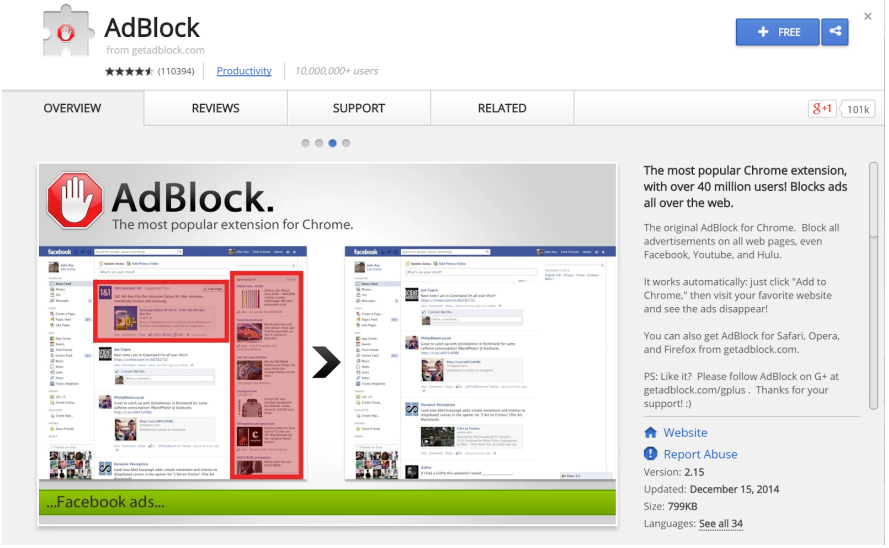
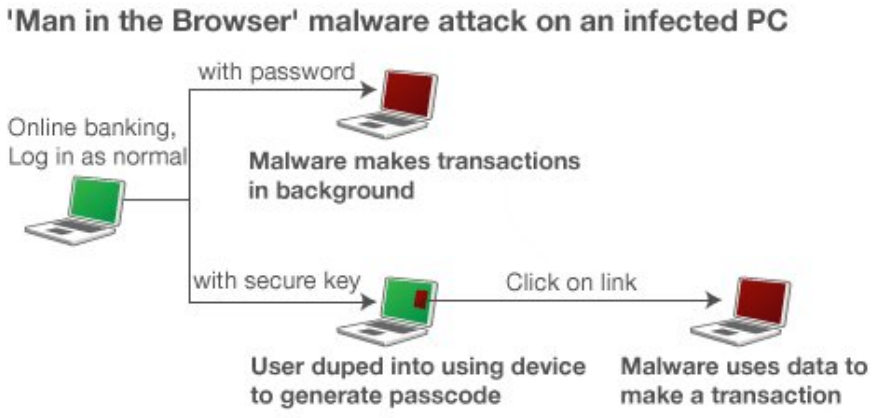
Threats and Vulnerabilities



1. Installation of Malware and malicious Extensions.
2. Benign-but-buggy Extensions.
3. Man in the Browser.
4. Code Injection.





Problems

- Lack of knowledge in browser's security aspects, could affect directly the development of applications and stakeholders.
- Scarce documentation and none unification of concepts. No formal descriptions for browser related concepts.

Reference Architecture (RA) for the browser

- Specifies the decomposition of the systems into subsystems, interactions between these parts and functionality distribution between them.
- Captures the essence of the architecture through a collection of similar systems, using architectonic reuse.
- Currently, there is no consensus in how to define an RA, what should have and how should be built. We use architectural patterns.
- Describes concerns and quality attributes needed.
- Helps: developers, in general stakeholders.
- Compares design decisions.
- Holistic view of the system.

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Security Reference Architecture (SRA)

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- Abstraction of defense mechanism described as security patterns.
- Unifies terminology.
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Securing a RA

- We start from a list of use cases which describe the typical cloud uses and their associated roles. Lists of cloud use cases are shown in [Bad12], [nis11], and [Has13c].
- We analyze each use case looking for vulnerabilities and threats as in [Bra08]. This implies checking each activity in the activity diagram of the use cases to see how it can be attacked. This approach results in a systematic enumeration of threats.
- We use the list of threats from [Has13a] to confirm these threats and to find possible further vulnerabilities and threats.
- These threats are expressed in the form of misuse patterns. We developed some misuse patterns for Cloud Computing in [Has13b], we show more later.
- We apply policies to handle the threats and we identify security patterns to realize the policies. There are also regulatory policies which are realized as security patterns.
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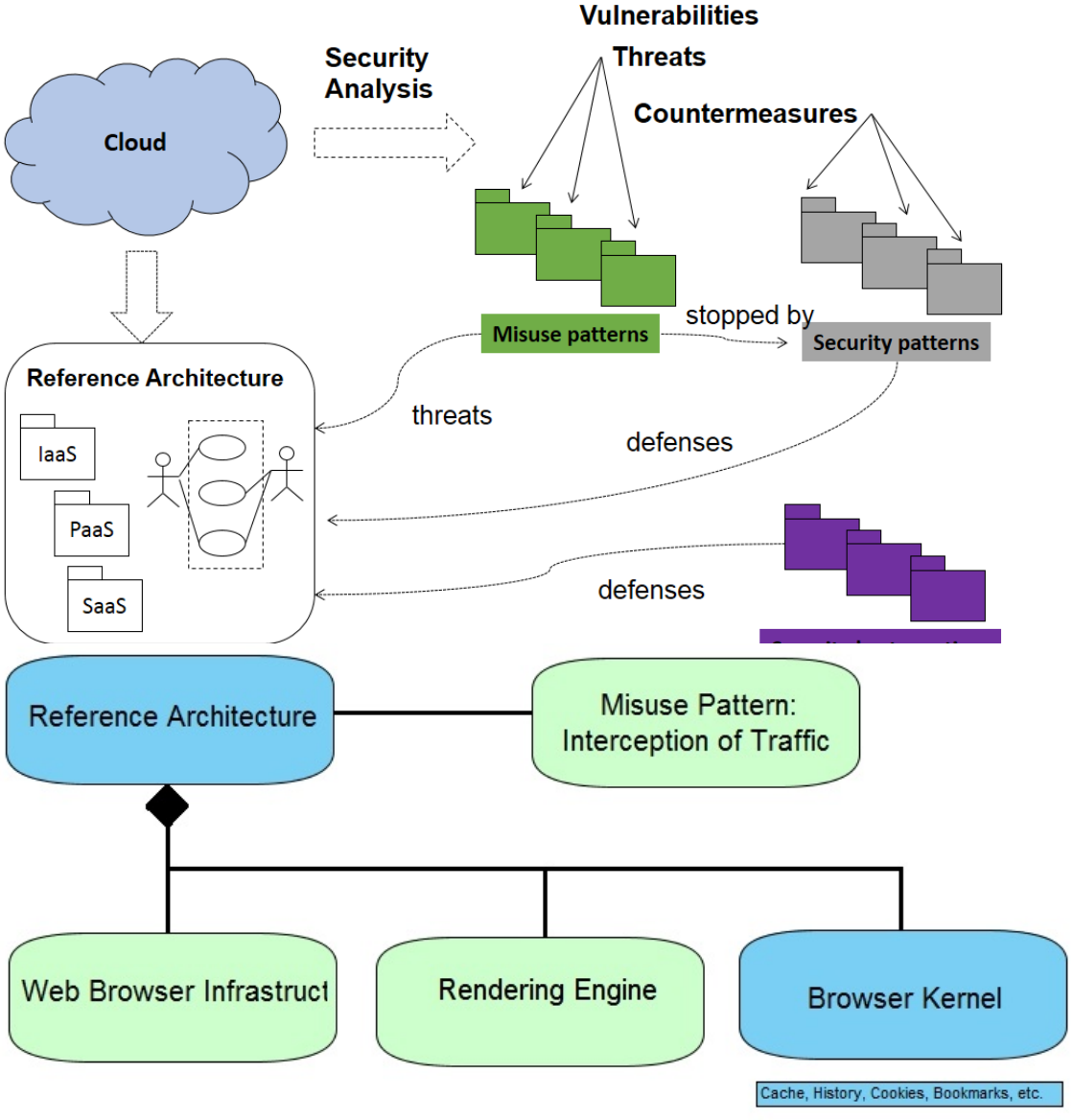
RA and SRA


Vulnerabilities
Threats
Countermeasures
Security Analysis
Cloud
Misuse patterns
stopped by
Security patterns
Reference Architecture
IaaS
PaaS
SaaS
threats
defenses
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Reference Architecture
Misuse Pattern: Interception of Traffic
Web Browser Infrastruct
Rendering Engine
Browser Kernel
Cache, History, Cookies, Bookmarks, etc.

RA and SRA

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- Value:
  - can be used to produce new concrete architectures
  - can be used to analyze the effect of threats
  - can be used to define monitoring points
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- Browser: Until now, there is no clear and precise model of the actual requirements and components. Only old models.

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- Have not found updated works about Reference Architectures of the Browser. The work of Grosskurth et al. [2] is close, but the technique is different.
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- Build an organized body of information about the Web Browser and its security.
- Systematize, organize and classify adquiered knowledge in a document, with a semi-formal format.
- Better comprehension of browser's security.

Specific objectives

- A guide to comunicate relevant concepts.
- Improve our Reference Architecture and continue our misuse pattern catalog.
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Hypotesis

Main Hypotesis

H1: The definition of a Security Reference Architecture for the Web Browser allows to abstract and capture main structural aspects, its behavior and security related requirements.

Validation

- Reference Architecture and Security Reference Architecture are not implemented. They are abstract models.
- Experts opinions.
- *PLoP conferences and “shepherding”process. Conferences: AsianPLoP y EuroPLoP.
- Experimental Software Engineering to validate or reject hypotesis.

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  - **Browser Infrastructure Pattern**. A pattern which abstracts web browser's architecture implementations and request/response communication (mostly, since implementations may differ).
  - **Web Content Renderer Pattern**. A pattern which abstracts th interior of the web browser's Renderer Engine.
  - **Browser Kernel Pattern** (not ready yet). A pattern which abstracts the principal component of the browser, like cache, cookies, bookmarks, network communication, etc.
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Side work

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  - A systematic mapping has been conducted to cover the existent technologies for identification and mitigation of security threats.
  - A total of 10 different techniques covering threats identification and 8 covering the mitigation of threats were found.
  - All the initiatives were integrated to at least one activity of the Software Development Lifecycle (SDLC), while 7 show signs of being adopted in the industry.
  - The mapping found only 15 studies that covered 11 different iniatiatives.
  - Only two techniques presented scientific evidence of its results through controlled experiments, while others selected studies presented informal case studies or examples.
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  - Only two techniques presented scientific evidence of its results through controlled experiments, while others selected studies presented informal case studies or examples.
- Fondecyt Project: Research
  - A Theoretical Framework for quality assessment of security metrics.
  - How to evaluate security in software development

Questions?

¡Muchas Gracias!, Thank you!, Arigatou Gozaimashita!, Grazie!


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