Browser Rootkits

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Agenda

Introduction

Why design a web browser rootkit?

Today's browsers

- Browsers are getting so complex that they can be considered as operating systems
- Browsers are usually allowed to access the Internet

Constraints

- Be as furtive as we can
- Be exploitable with user rights only

FIREFOX

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Main principles

Build a Firefox add-on like a traditionnal rootkit kernel module

Attributes:

- Loads and becomes persistent
- Hides itself (from the browser scope)
- Communicates and answers to orders

Constraints:

- Exploitation with minimal user rights
- Focus on the stealth of the solution
- Multiplatforms

What is an extension?

An extension...

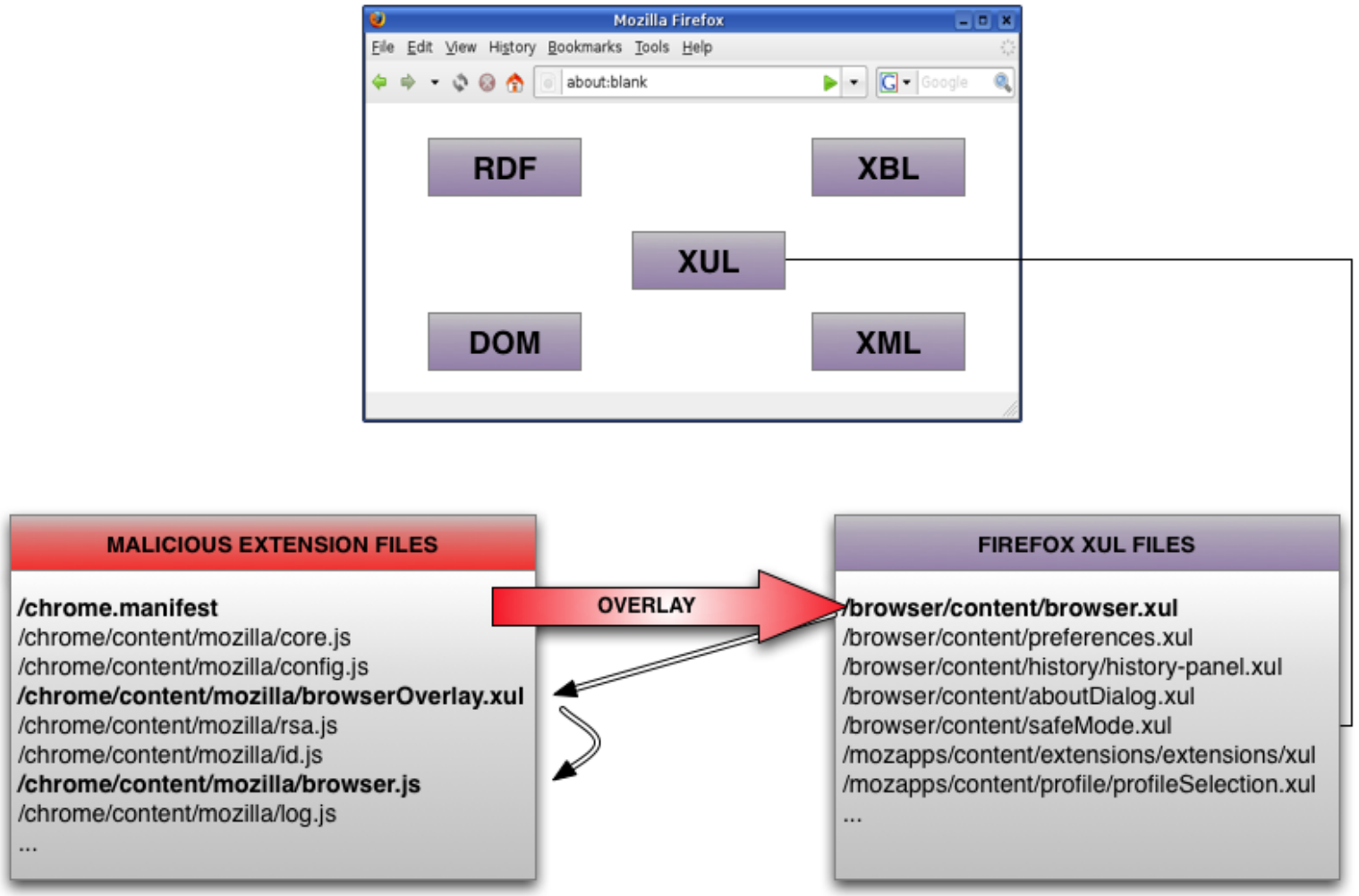
- is a simple compressed file with JavaScript/XUL/CSS/binaries/...
- can be platform independent
- adds **overlays** on Firefox XUL files

An overlay provides a mechanism for:

- adding new user interfaces
- overriding pieces of an existing XUL file
- reusing particular pieces of the user interface

With an overlay on *browser.xul*, we can control the main Firefox window.

What is an extension?



Installation

Traditional installation:

XPI package installed by social engineering, emails, P2P, ...

Using an infector:

Executable which edits Firefox Extensions Manager files

Using a vulnerability in Firefox:

Which allows a code execution (MFSA 2008-34, MFSA 2008-41, ...)

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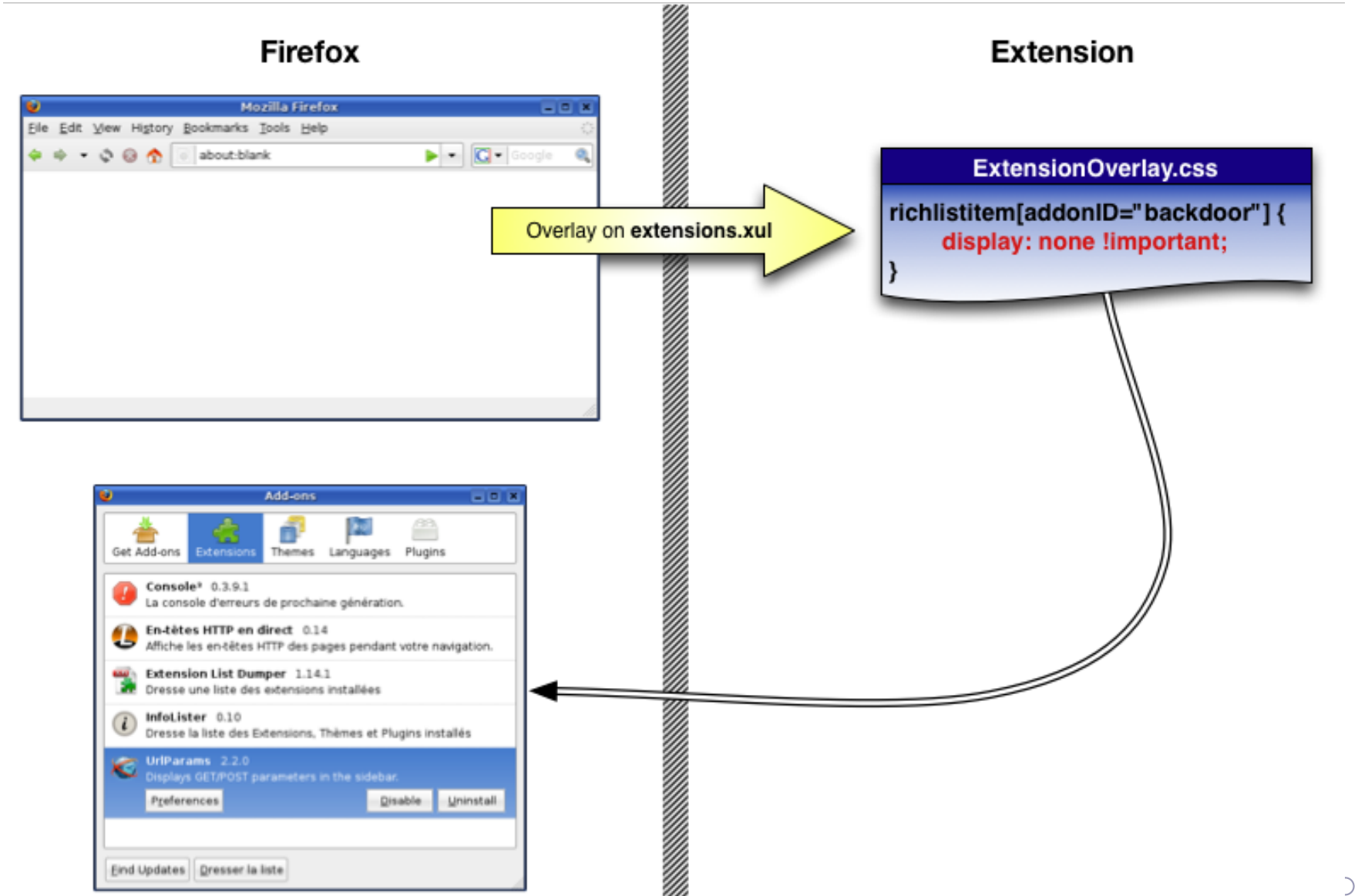
Hide the extension

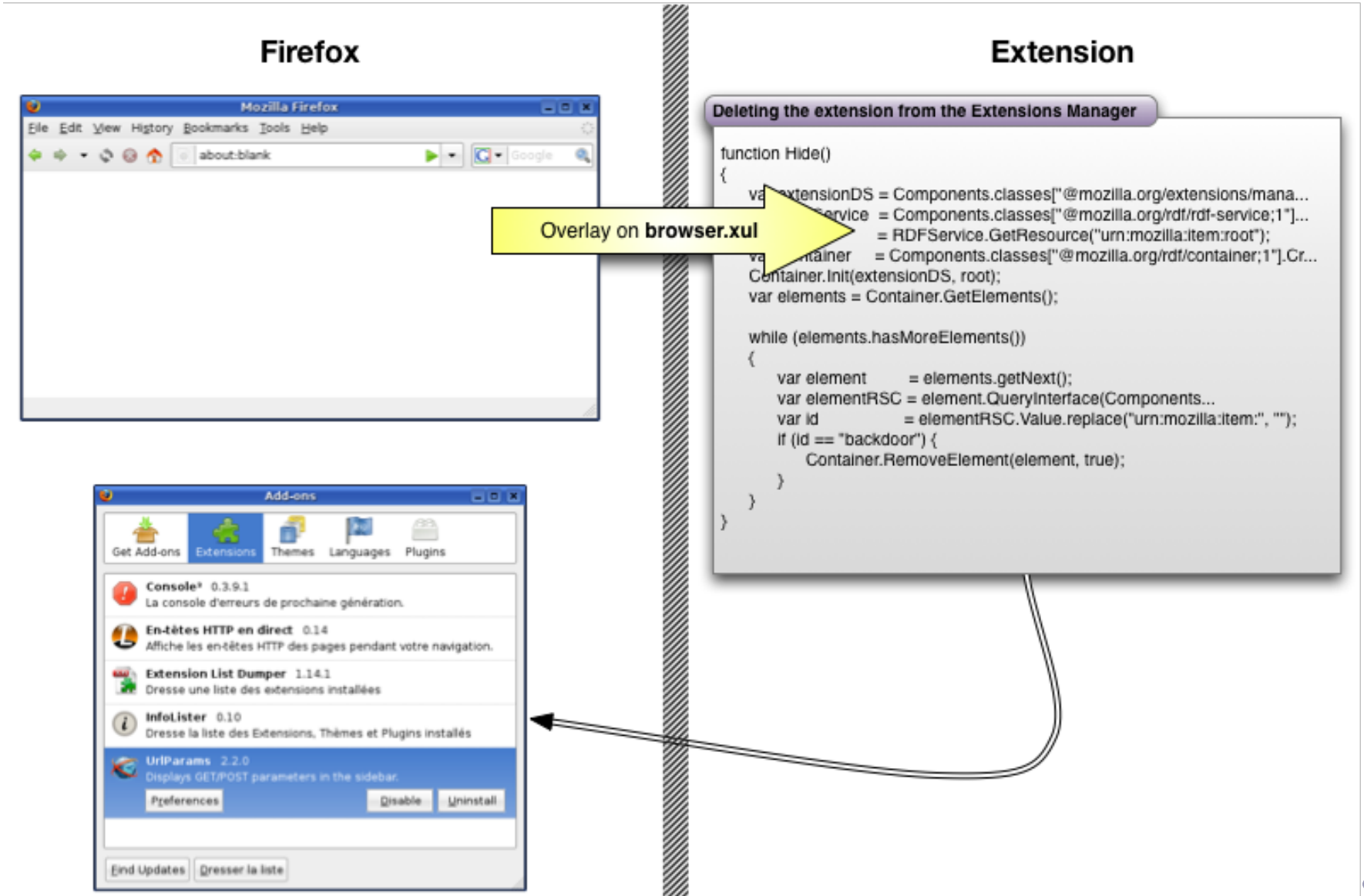
Three methods:

- Using a Cascading Style Sheets file:
  - **User** doesn't see the extension
- Removing the extension from the Extensions Manager component:
  - **Firefox** doesn't see the extension
- Infecting an already installed extension:
  - Traditional virus behavior

Hide the extension



Hide the extension



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Communication

Communication process:

- Communication with an external HTTP(S) server: Bypass firewalls
- XMLHttpRequest
- Ask, execute, send back to master
- Encrypted protocol (not fully implemented) using RSA and RC4

Communication: the attacker webcontrol

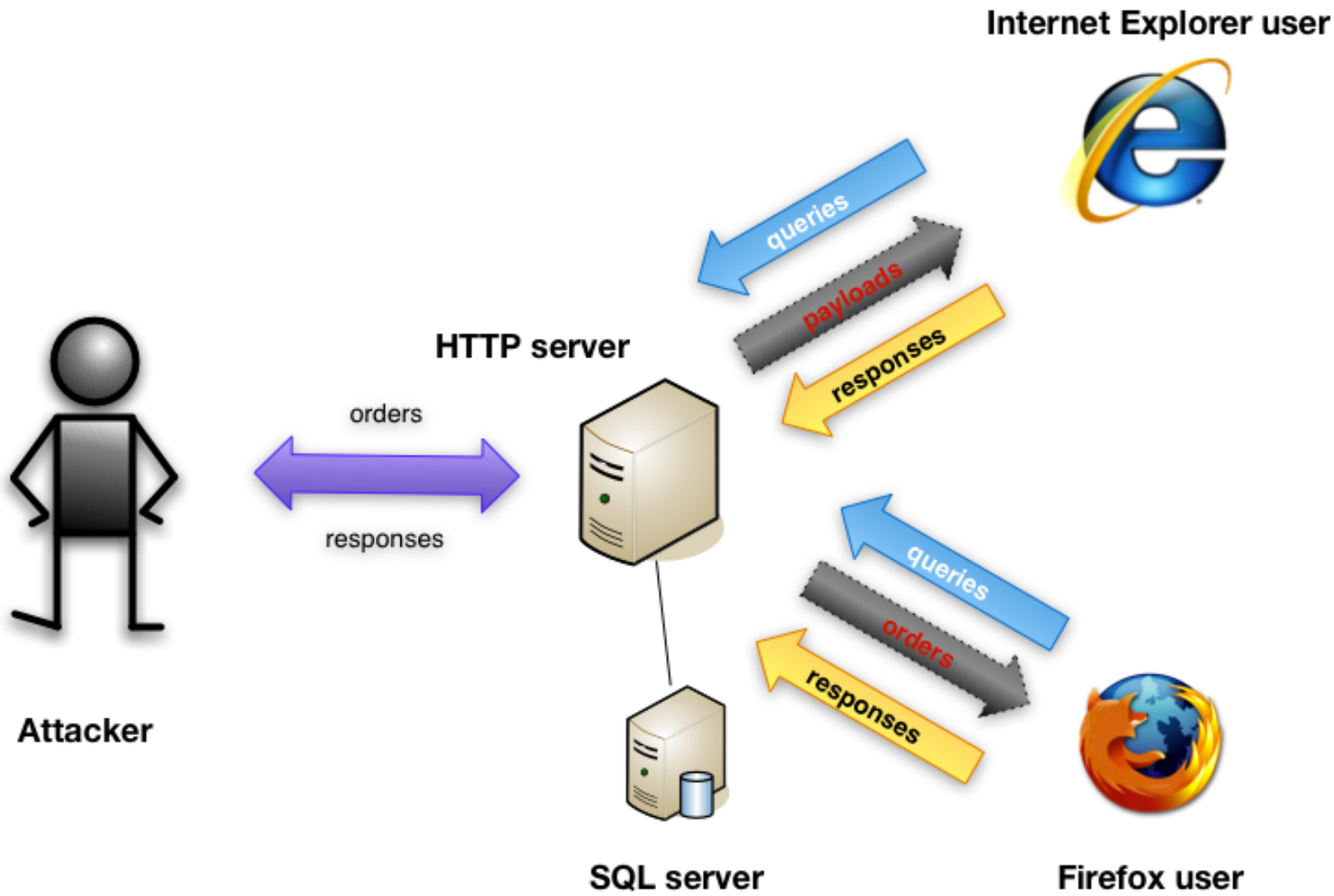
Why use web server to control browser rootkits?

- Browsers communicate by nature with web servers
- Sending, receiving and parsing HTTP/XML requests is supported natively by web browsers

Remark

The web server can easily be hidden using a fast flux like method

Global architecture



Spreading

Spreading mechanisms:

- Traditional ways: mails, P2P, others worms, ...
- Hooks on webmails forms: catch emails and add an infector as attachment
- Harvest all emails in web pages (Firefox can send emails by itself)

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XPCOM

XPCOM (Cross Platform Component Object Model)

- multiple language bindings
- includes interfaces for:
  - Component management
  - File abstraction
  - Object message passing
  - Memory management

	Component	Interface	Method
Passwords	login-manager	nsILoginManager	getAllLogins()
Cookies	cookiemanager	nsICookieManager	enumerator
Bookmarks	nav-bookmarks-service	nsINavBookmarksService	executeQuery()
History	nav-history-service	nsINavHistoryService	executeQuery()
Execute	process/utils	nsIProcess	run()
Use socket	network/socket-transport-service	nsISocketTransportService	CreateTransport()

AddEventListener

AddEventListener

- Associates a function with a particular event
- Useful to spy on the user activity

Action	Event to listen	
a tab is open	DOMContentLoaded	log browsing
a tab is close	TabClose, unload	log browsing
a key is press	keypress	keylogger

- Logging is completed by HTTP headers sniffing
- Logs are stored encrypted in the browser cache

Payloads

From there, anything is possible 

- Passwords/Cookies/Bookmarks/History stealer
- Keylogger
- ConnectBack
- Sniffer (HTTP requests)
- Botnet
- Spam platform
- Disable teflon :)
- ...

Demo

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Conclusion

- A real **design** problem and no real solution
- Malicious Firefox extensions are easy to develop
- There is NO security about extensions in Firefox

We would not be surprised to see this kind of spyware spread in the future

INTERNET EXPLORER 7

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Security zones

Five security zones

- Local computer: web pages on local hard drives
- Intranet: web pages on the intranet
- Trusted sites: whitelist of trusted web sites
- Internet: all pages that do not match any other zone
- Restricted sites: blacklist of restricted web sites

Security flags

ACTION_FLAGs

Represent all actions that can be taken in a security zone

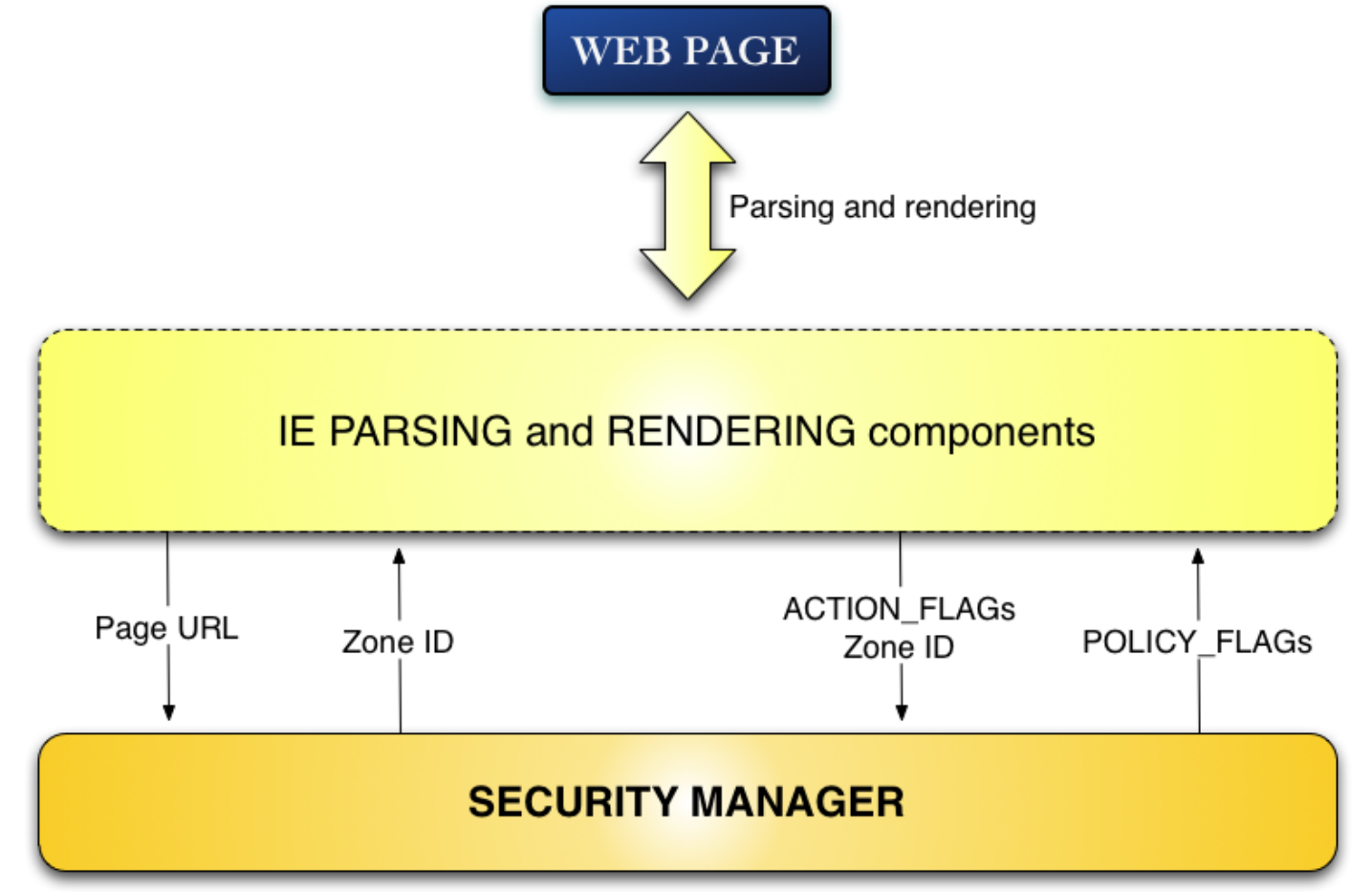
POLICY_FLAGs

Represent how the browser will react to a required ACTION_FLAG

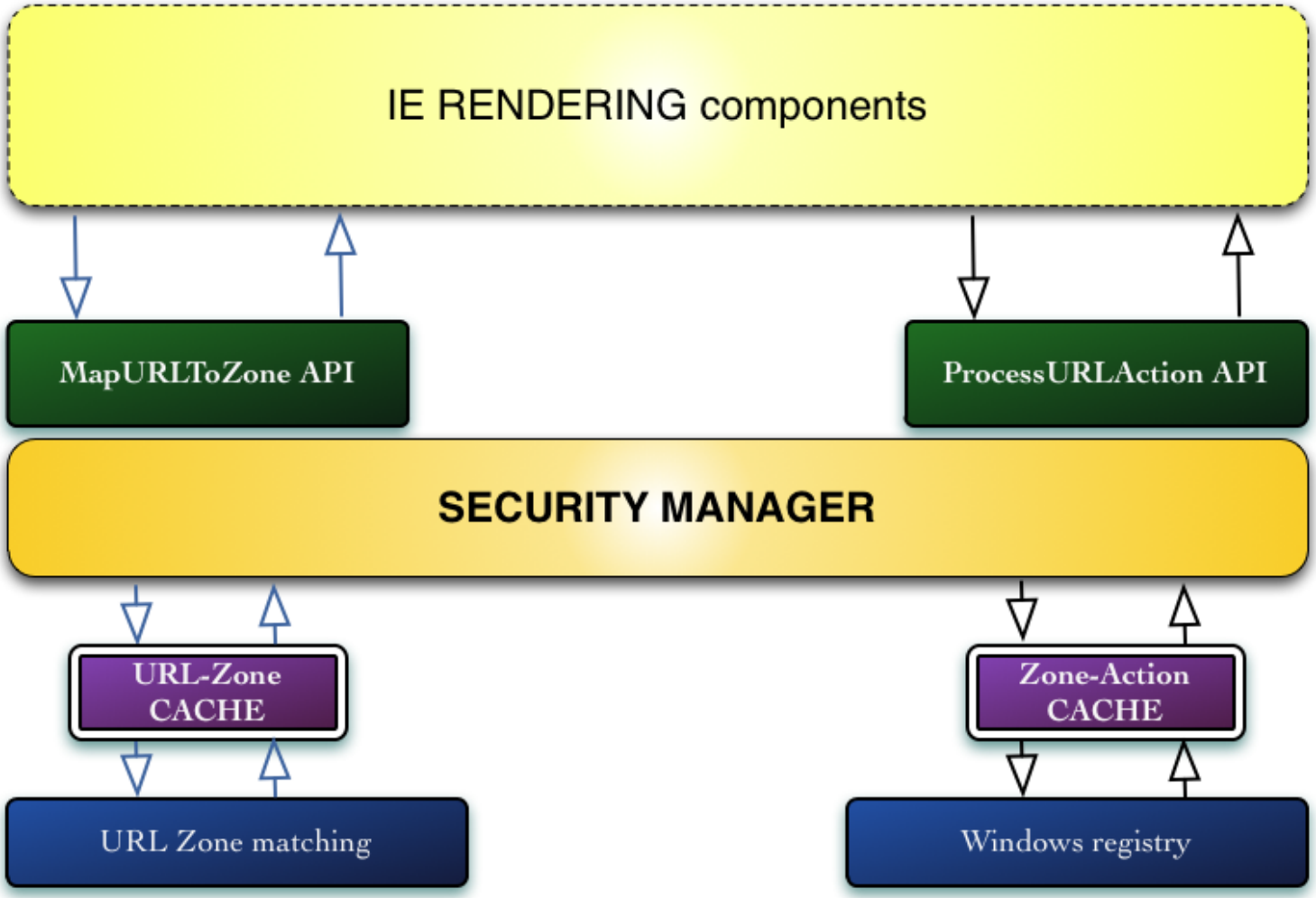
Security policy

Each zone has its own set of ACTION_FLAGs and POLICY_FLAGs which defines its security

Security applied to a web page



Security manager overview



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Internet Explorer rootkit

Constraints

- Being usable with user's rights
- All in memory architecture to be furtive
- Using IE functionnalities to be furtive

Why not use a Browser Helper Object?

- BHOs require high level privileges to be installed
- BHOs leave fingerprints in the registry
- BHOs are signed and checked by IE

Howto

Let http://evilsite be the rootkit owner's webserver address

Howtos

- Get high level privileges for pages hosted on http://evilsite
- Load pages and execute them without beeing seen
- Stay connected to the attacker via http://evilsite

Injector

The purpose of the injector is to inject our rootkit code inside IE's context

Methods that may be employed

- Inject the code using another process on the victim's computer
- Inject the code remotely using a vulnerability
- Inject the code using a malicious plug-in

We focus on rootkit architecture so we are using a simple dll injection

Granting privileges: security manager cache poisonning

URL-Zone cache

Corrupting URL-Zone cache to map http://evilsite to the zone we want

Zone-Action cache

Corrupting Zone-Action cache to give high privileges to the zone http://evilsite is mapped to

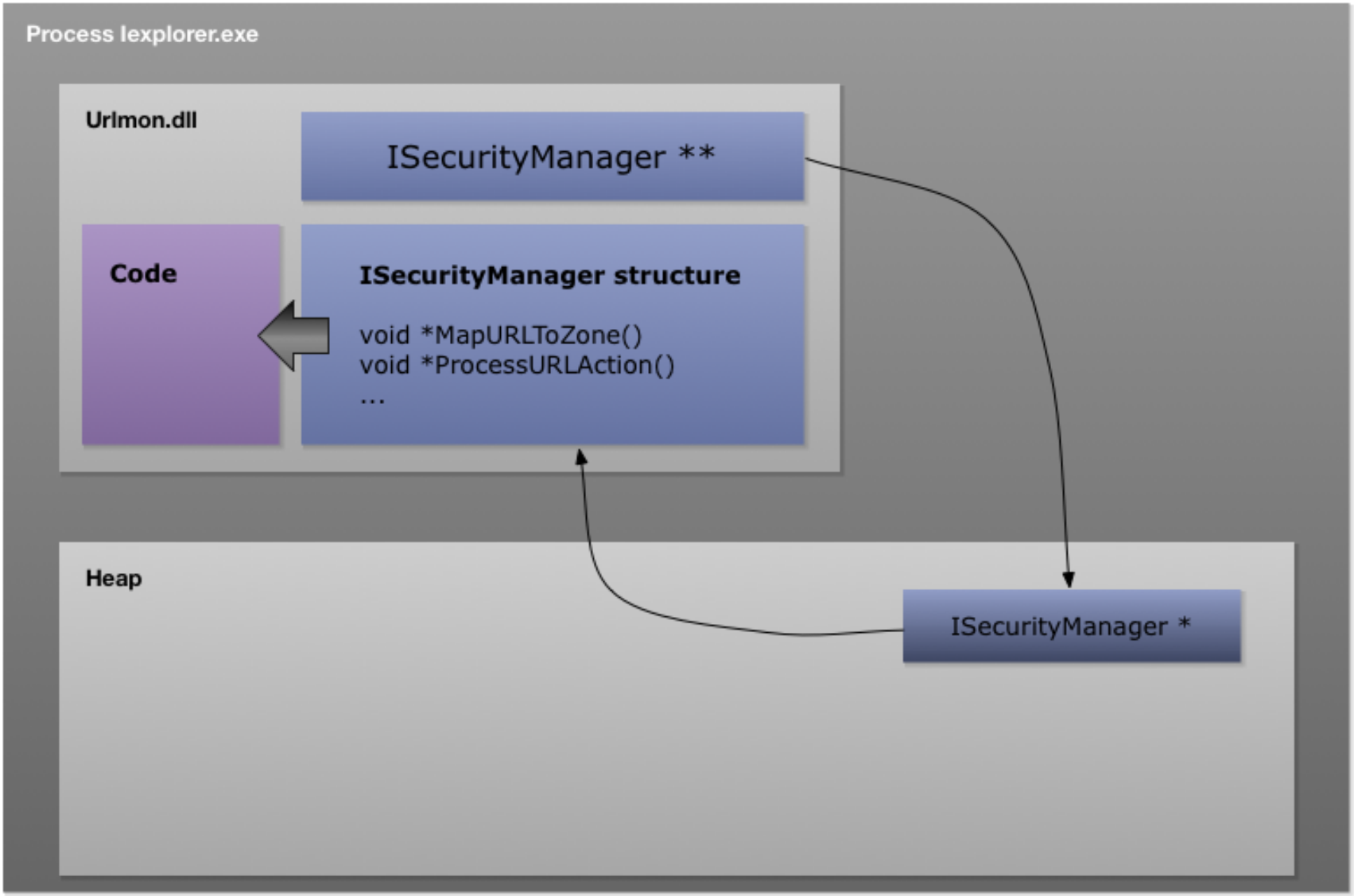
Results

http://evilsite will have high privileges

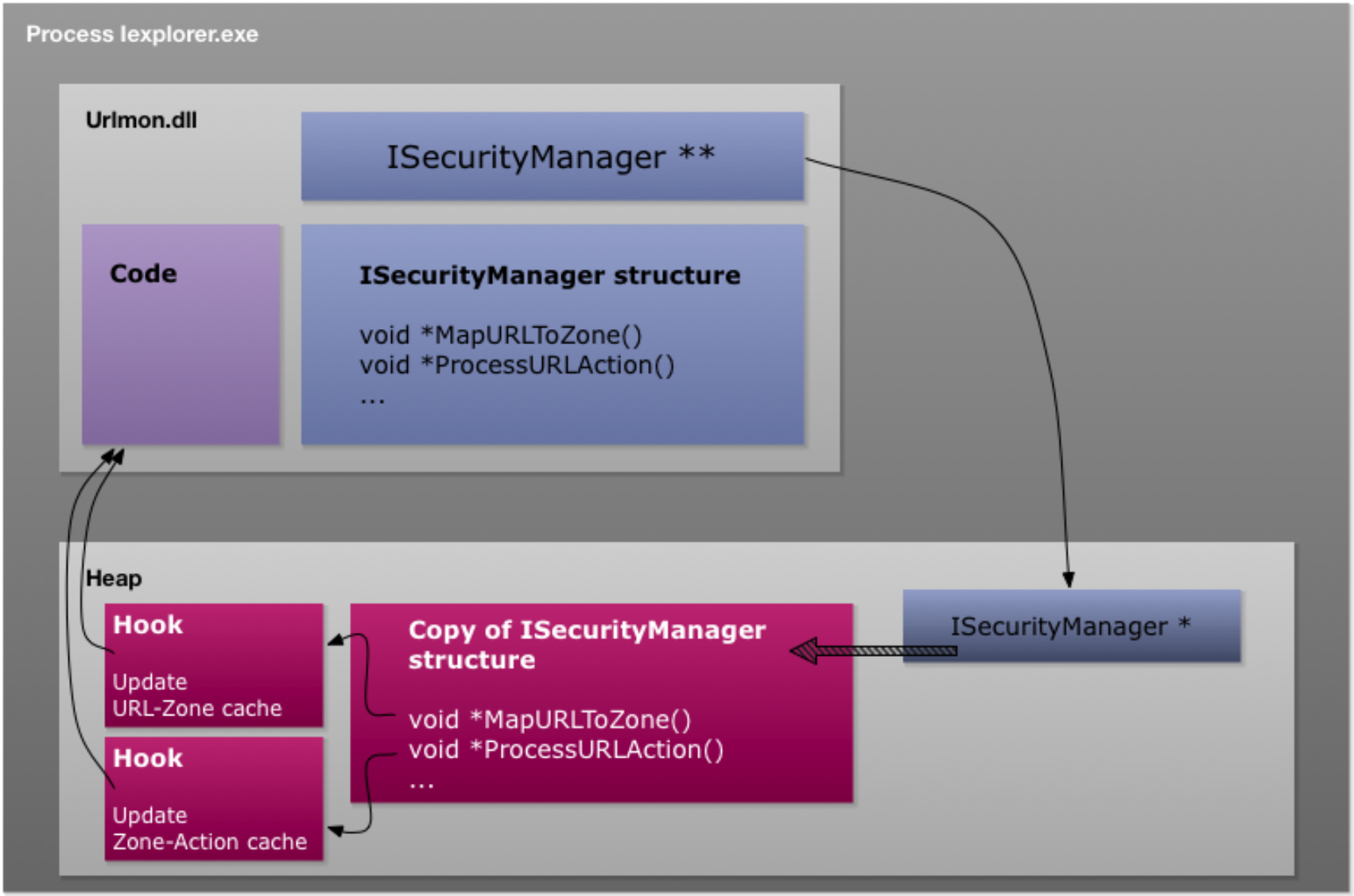
Problem

How to keep cache corrupted?

Hooking the security manager



Hooking the security manager



Hooking the security manager

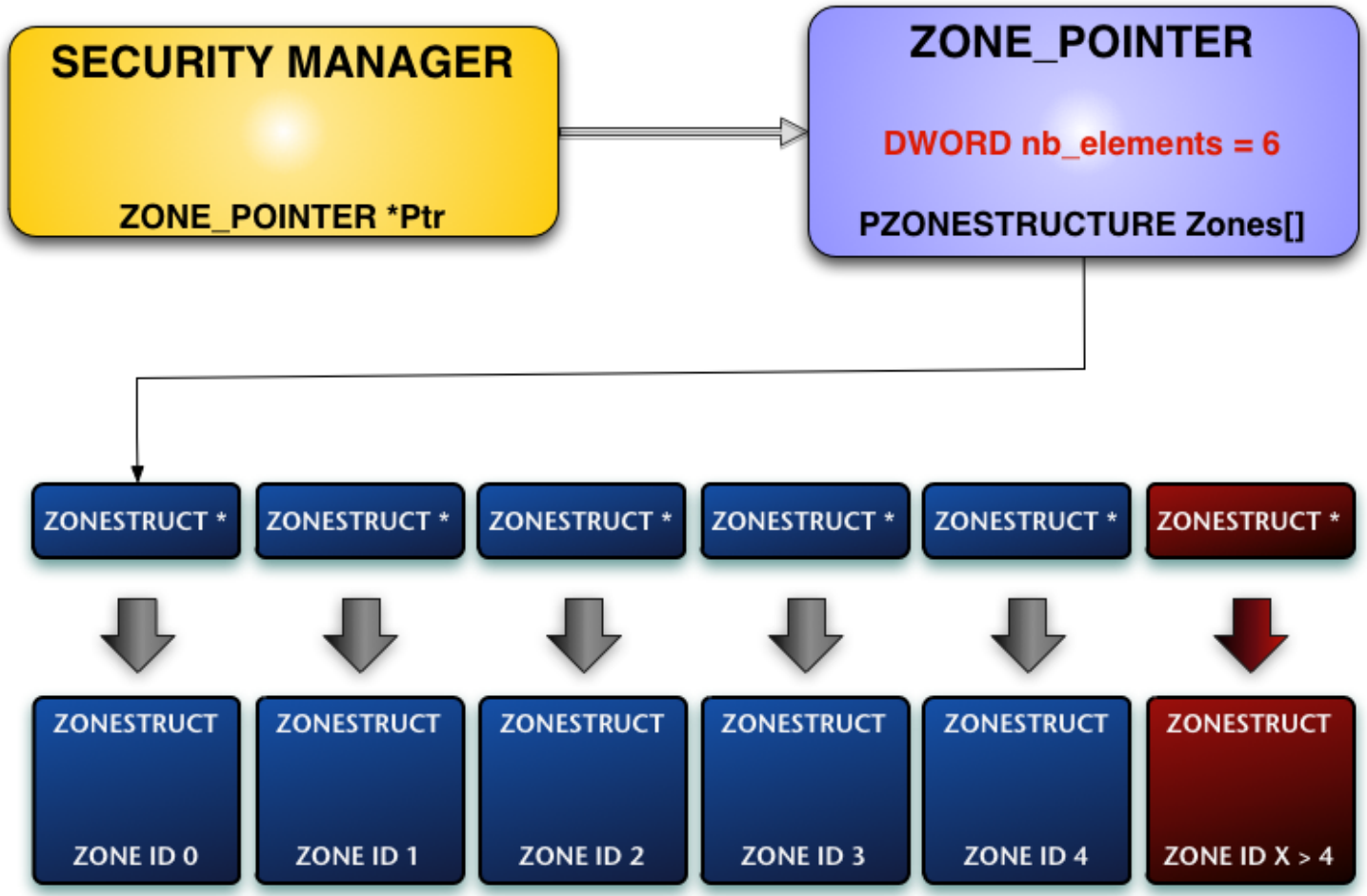
Results

- Caches will remain corrupted regardless to the registry configuration and user's actions

Problem

Any other site in the corrupted zone will have high privileges

Adding a new zone



Adding a new zone

Results

- Only http://evilsite is mapped to the newly created zone
- The newly created zone will get its rights increased, default zones' configurations will not be modified

Problem

Some functionalities are still unavailable in new zones

Loading and executing pages: invisible tab

Internet Explorer 7 is a multitab browser:
What about loading and executing http://evilsite pages in a new tab?

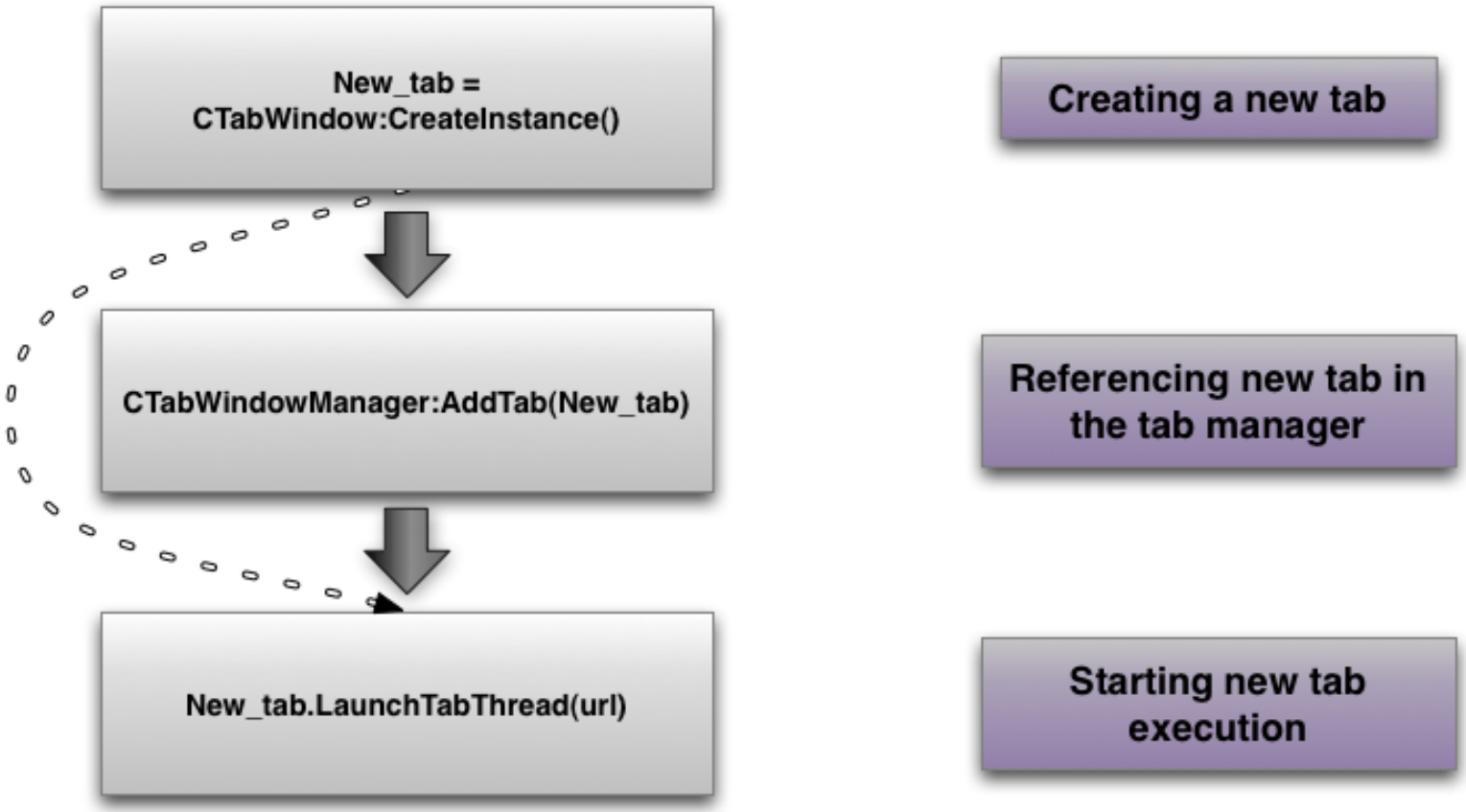
Problem

Creating a new tab is anything but furtive!

Answer

Create an invisible tab...

Loading and executing pages: invisible tab



Communication web page

The communication web page is loaded by the invisible tab

Technology used

- Javascript and AJAX.

Actions

- Gets queued orders from attacker's web server
- Loads payloads
- Executes payloads
- Sends back results to attacker's web server

Payloads

Payloads implement functionalities offered by the rootkit

Technology

- Javascript
- ActiveX scripts

Fonctionalities

- Create / Read / Write / Delete files on and from victim's computer
- Read / Write into windows registry
- Create processes

INTERNET EXPLORER 7

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Conclusion about Internet Explorer 7 rootkit

Browser rootkits are analogous to kernel rookit

- Creating new browser objects (tabs, zones)
- Using browser internal functions

Furtiveness

- Entirely in memory approach: allocating new memory or modifying existing data

To do

- Make the rootkit persistent to IE process re-launch or computer reboot
- Make new zones fully functional