Cache, Trigger, Impersonate: Enabling Context-Sensitive Honeyclient Analysis On-the-Wire

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University of North Carolina at Chapel Hill

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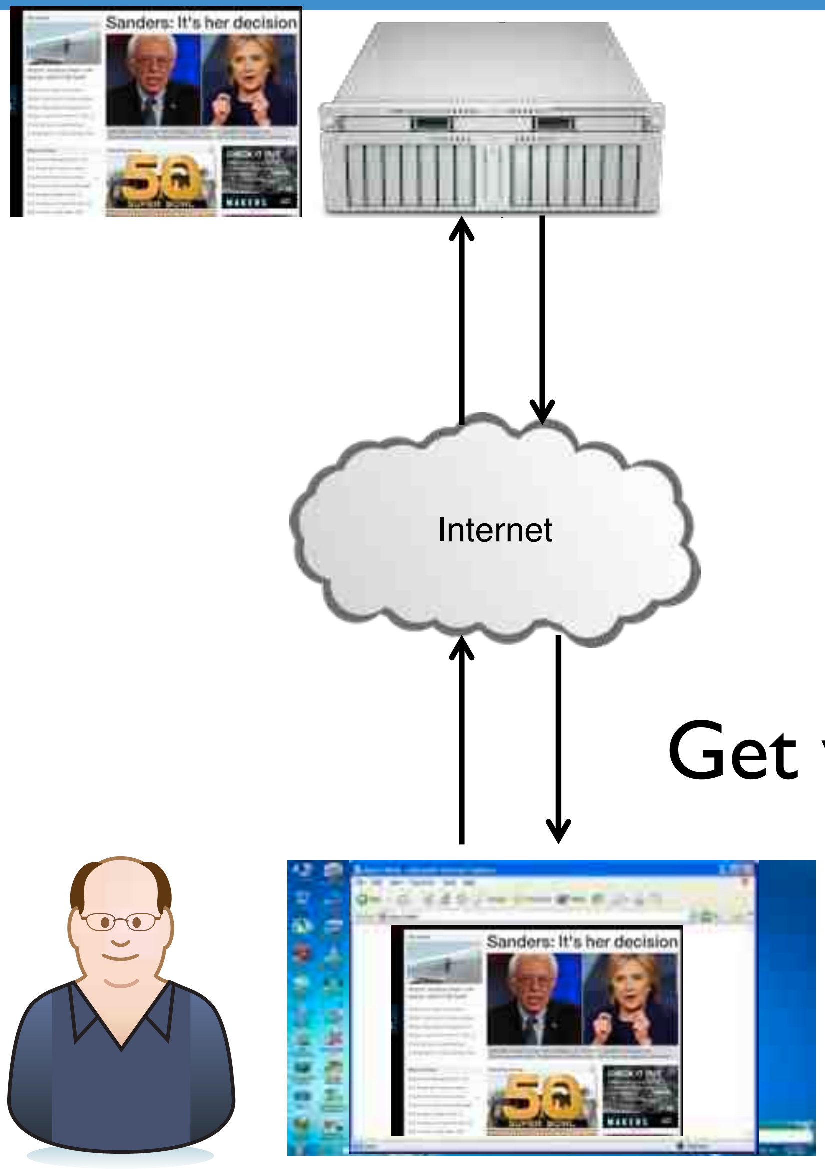
Motivation



Get www.somenews.com

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Motivation

Sanders: It's her decision

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<html>

<h1>Sanders: It's her
decision</h1>

<iframe
src="http://www.exploitkit.com"/>


</html>
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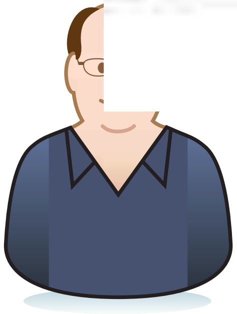

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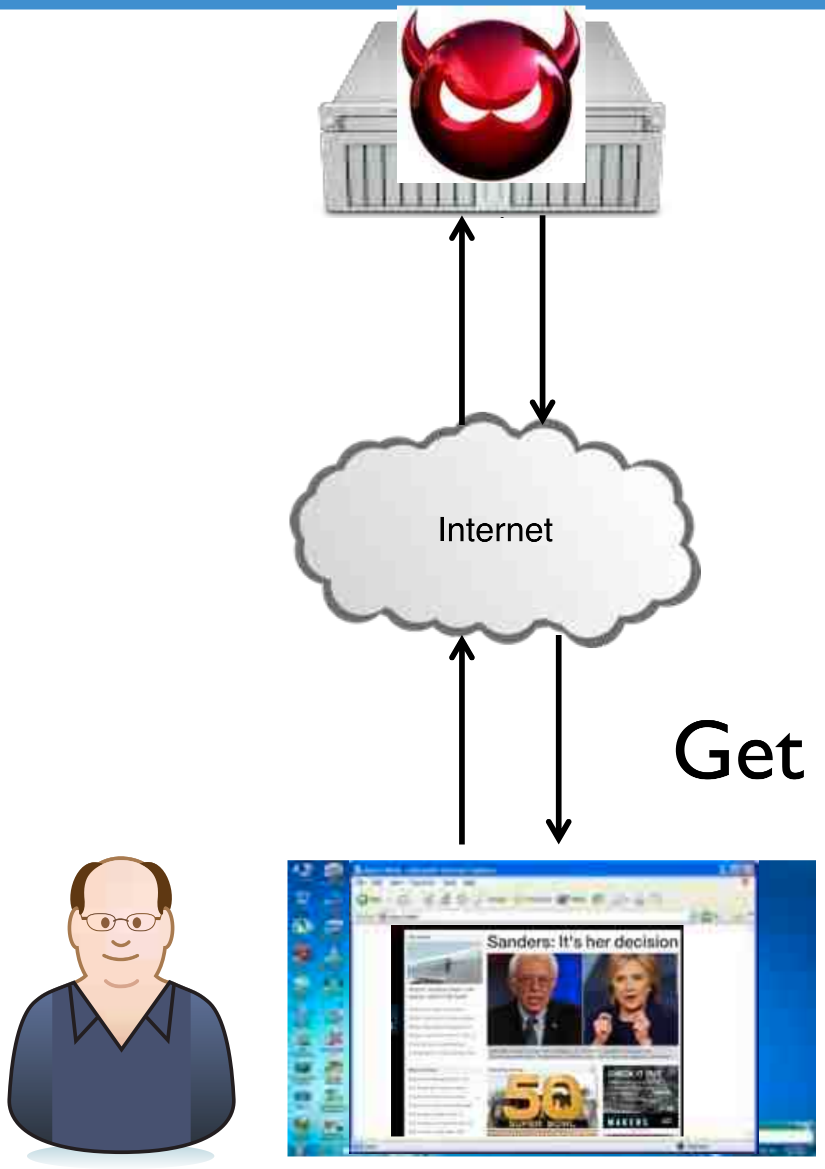

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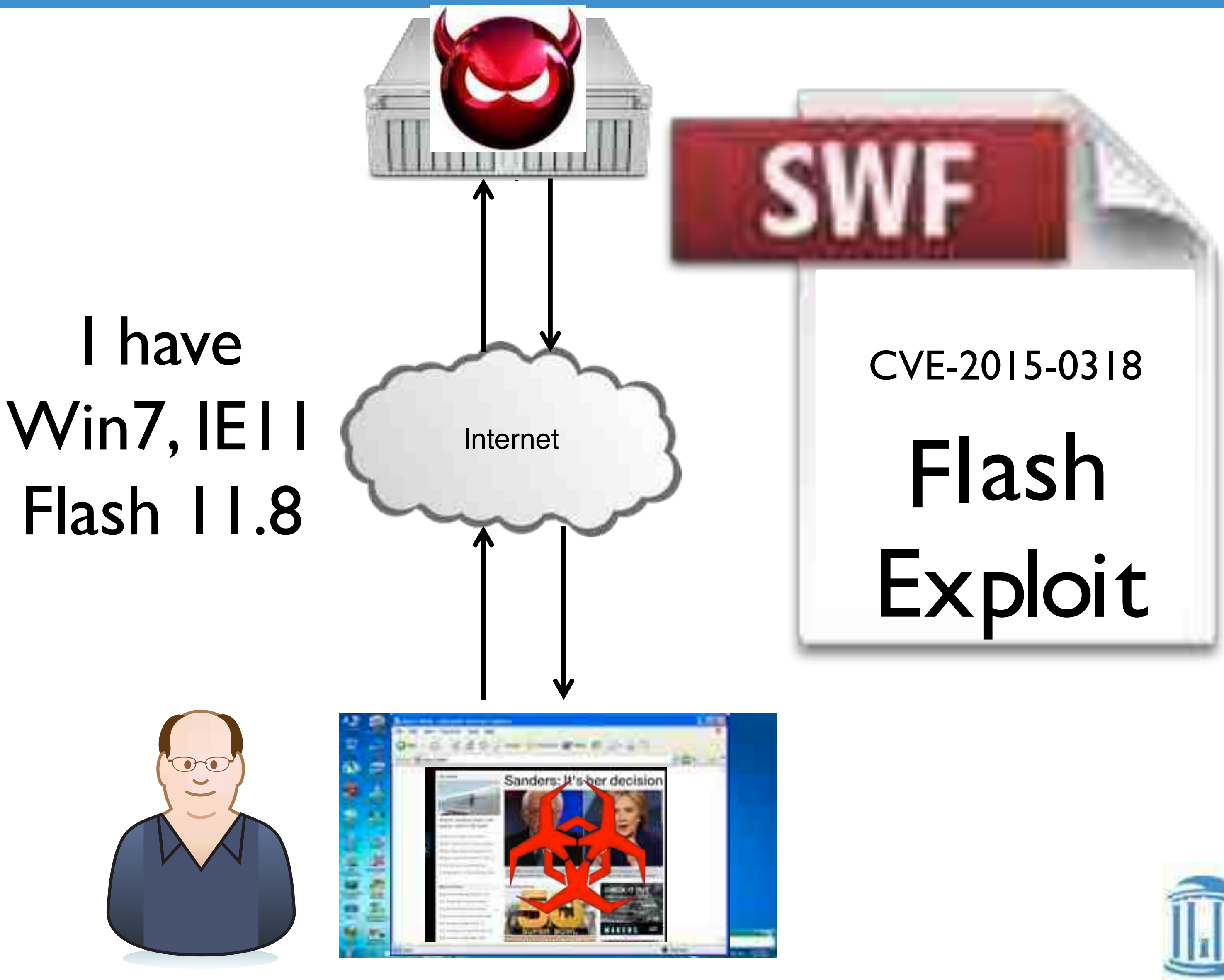
Motivation



I have
Win7, IE11
Flash 11.8

CVE-2015-0318

Flash
Exploit

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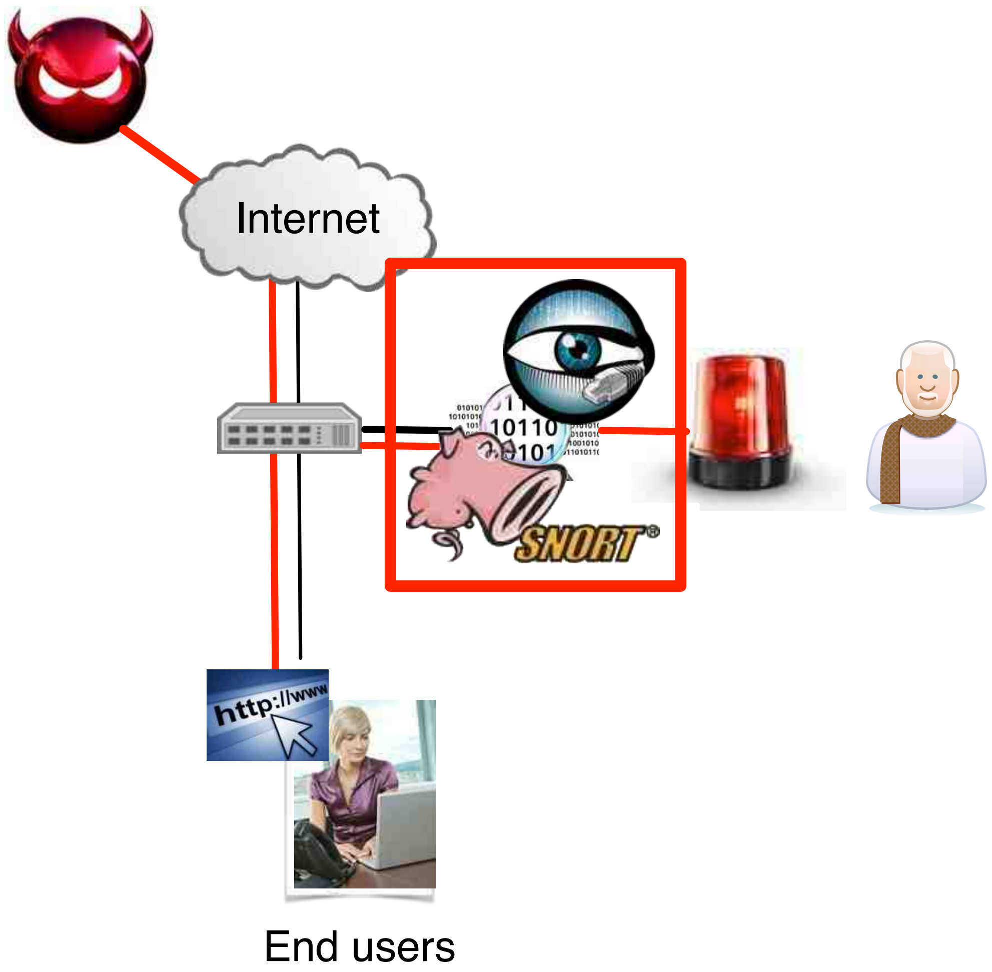
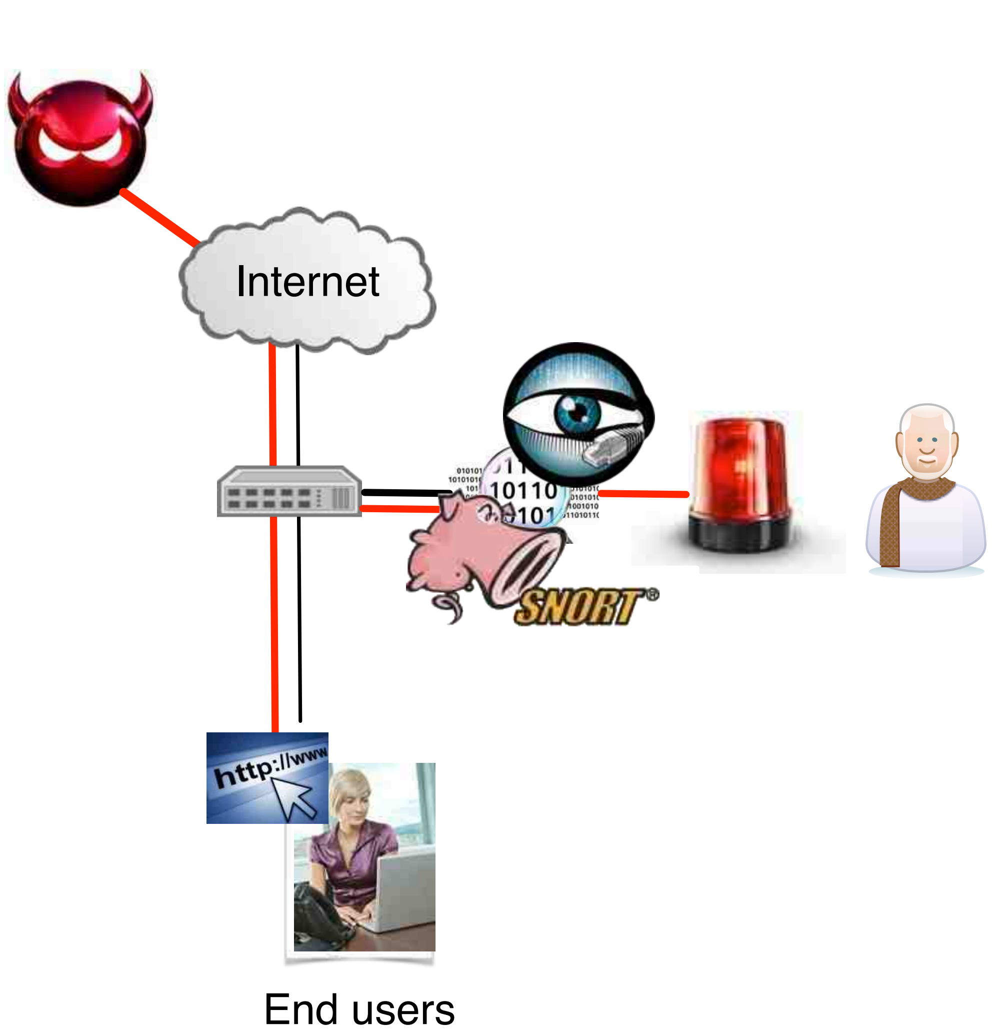
Current Approaches

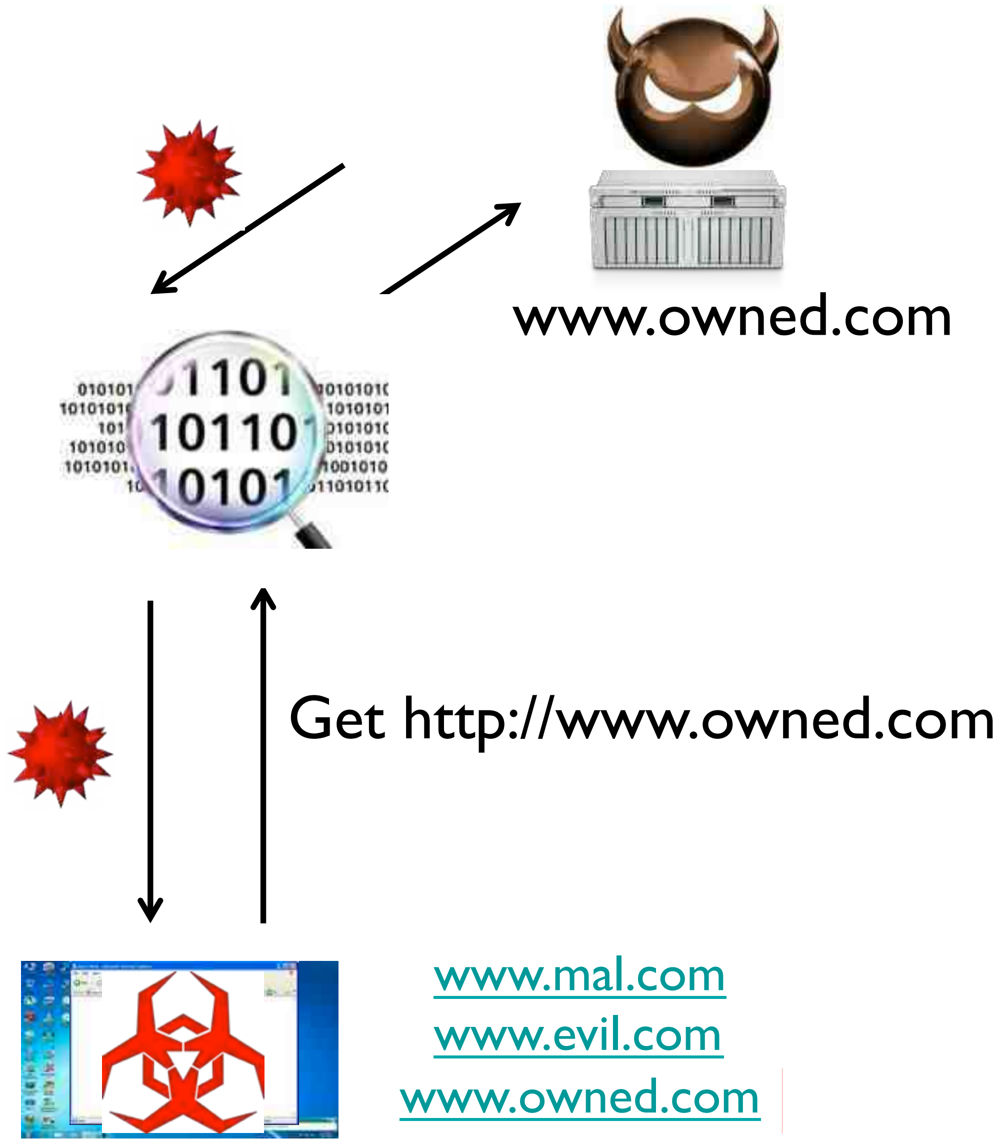


Current Approaches



Internet

End users



www.owned.com

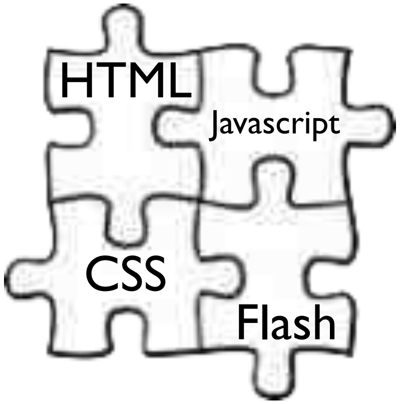
Get http://www.owned.com

www.mal.com
www.evil.com
www.owned.com

Operational Challenges and Constraints

- Limit interaction with the client or server.
- Must handle the fire hose of data.

- Attackers spread exploits across multiple web resources.



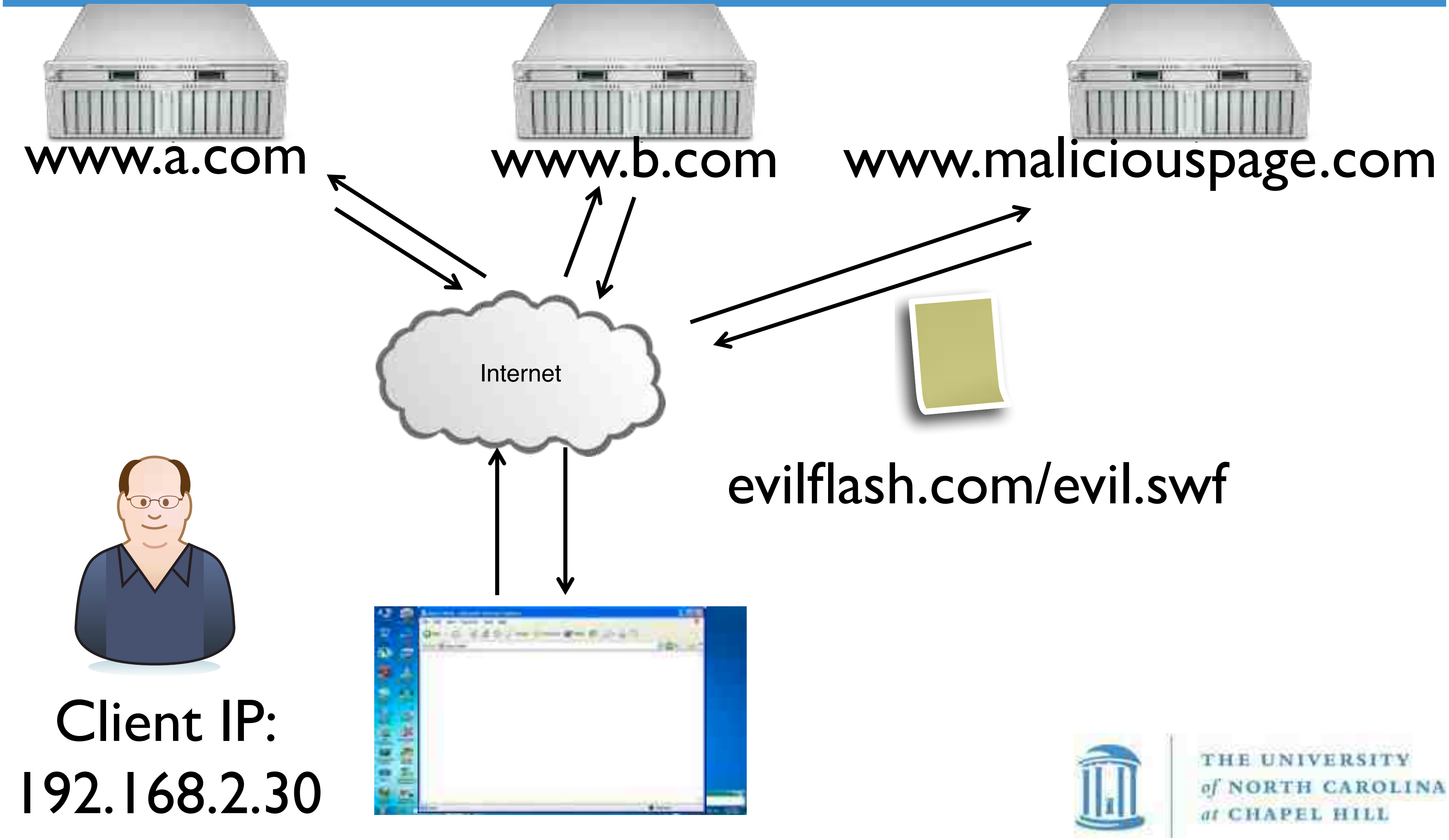
- Limited to memory storage.

Framework

- CACHE:
  - A small time window of traffic.
- TRIGGER:
  - On a potentially exploitable file type.
  - Flash comprises 75% for popular kits.

- IMPERSONATE:
  - The client and server using the semantic cache and a honeyclient.

Example



www.a.com

www.b.com

www.maliciouspage.com

evilflash.com/evil.swf

Client IP:
192.168.2.30

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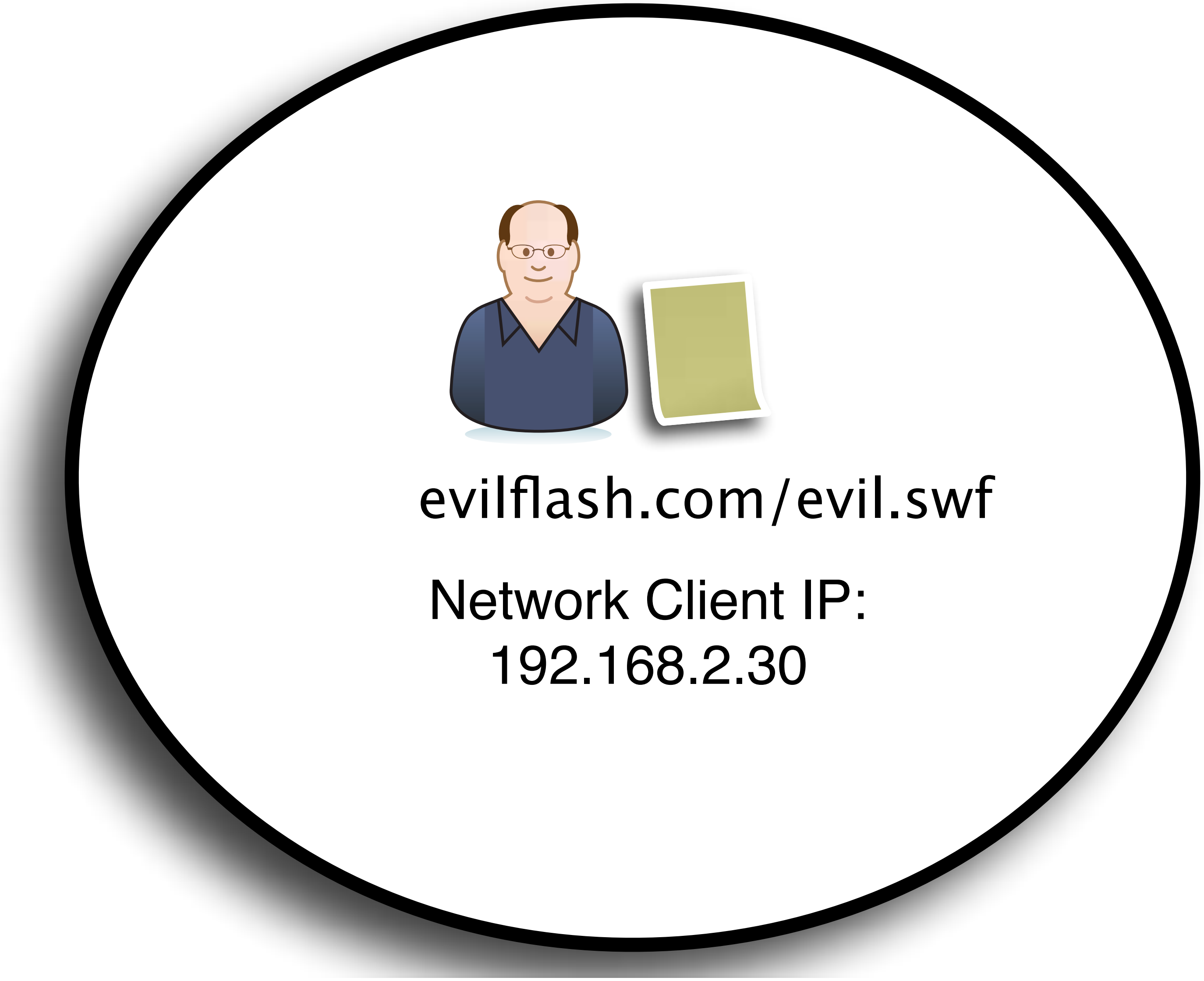
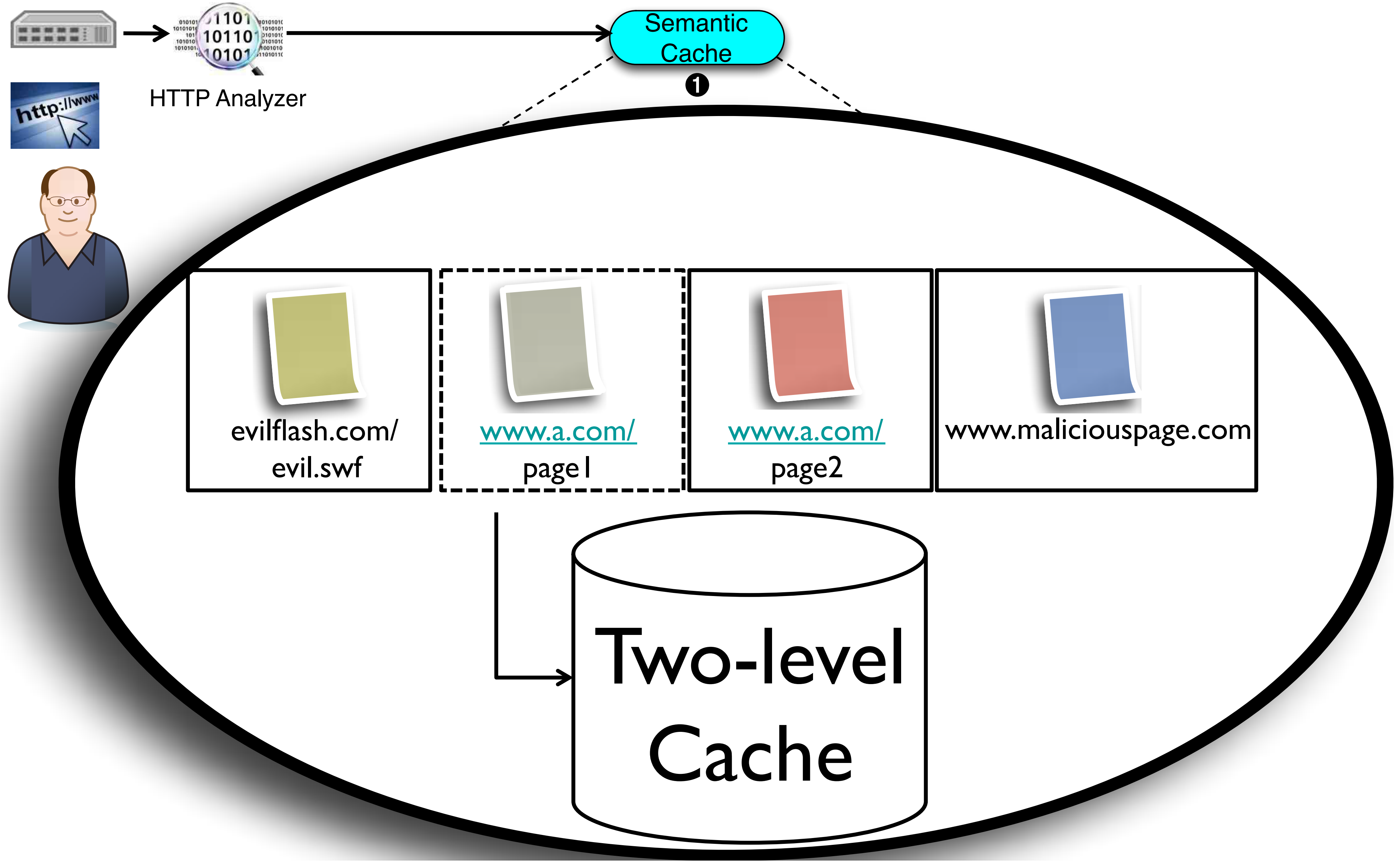
Example Cont'd



evilflash.com/evil.swf

Network Client IP:
192.168.2.30

CACHE



HTTP Analyzer

Semantic Cache

❶

evilflash.com/ evil.swf

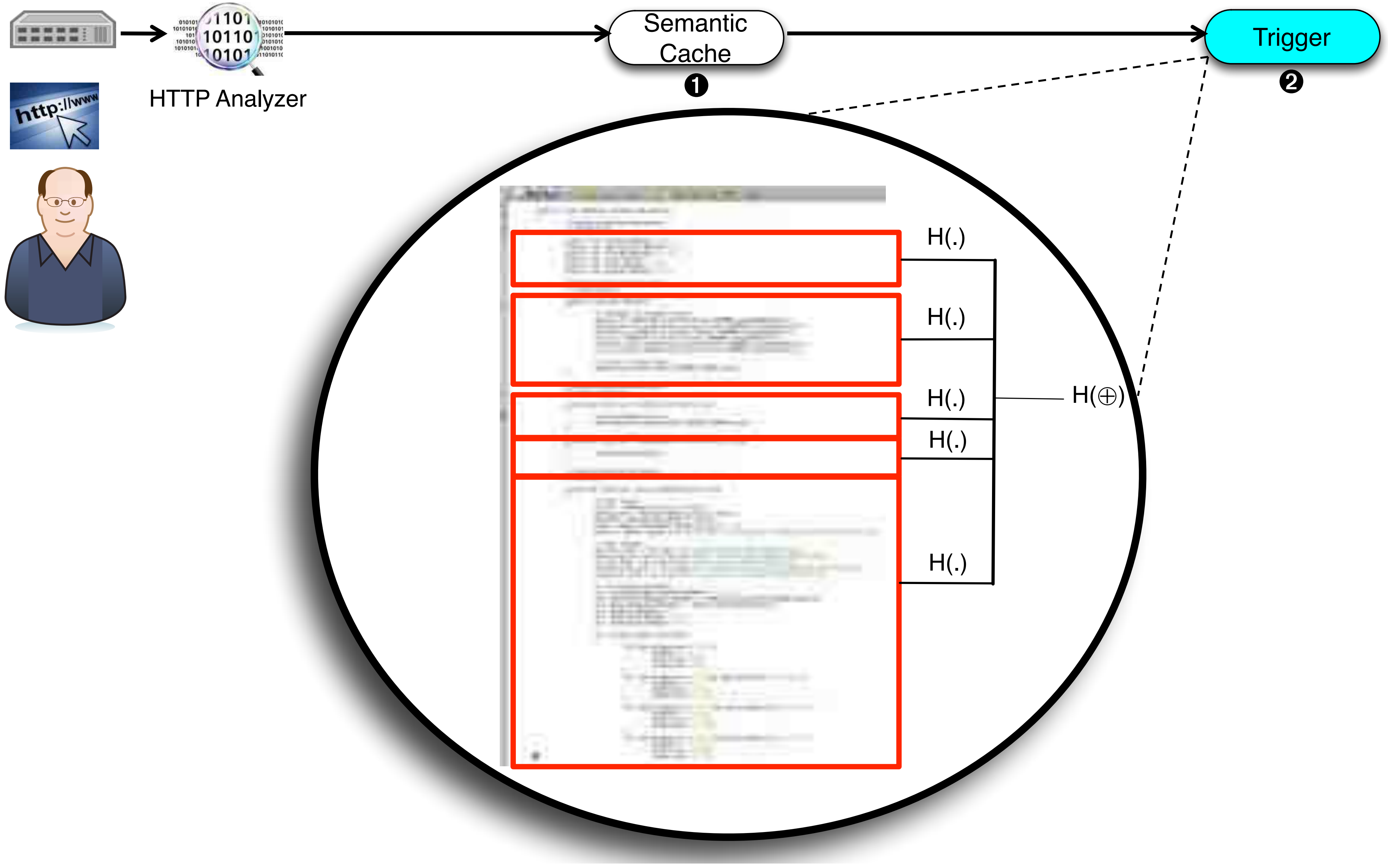
www.a.com/ page1

www.a.com/ page2

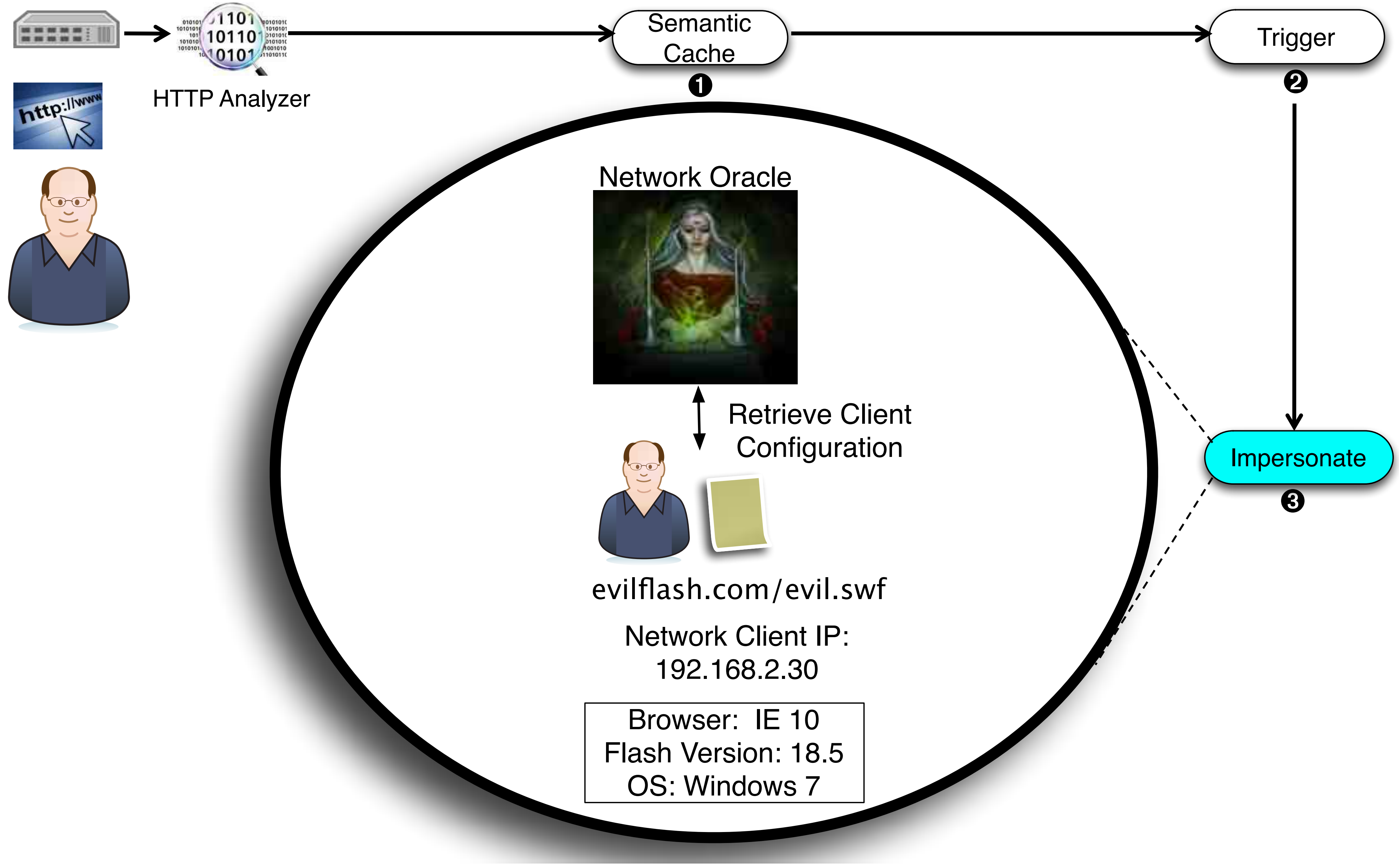
www.maliciouspage.com

Two-level Cache

TRIGGER



IMPERSONATE



HTTP Analyzer

Semantic Cache

❶

Trigger

❷

Impersonate

❸

Network Oracle

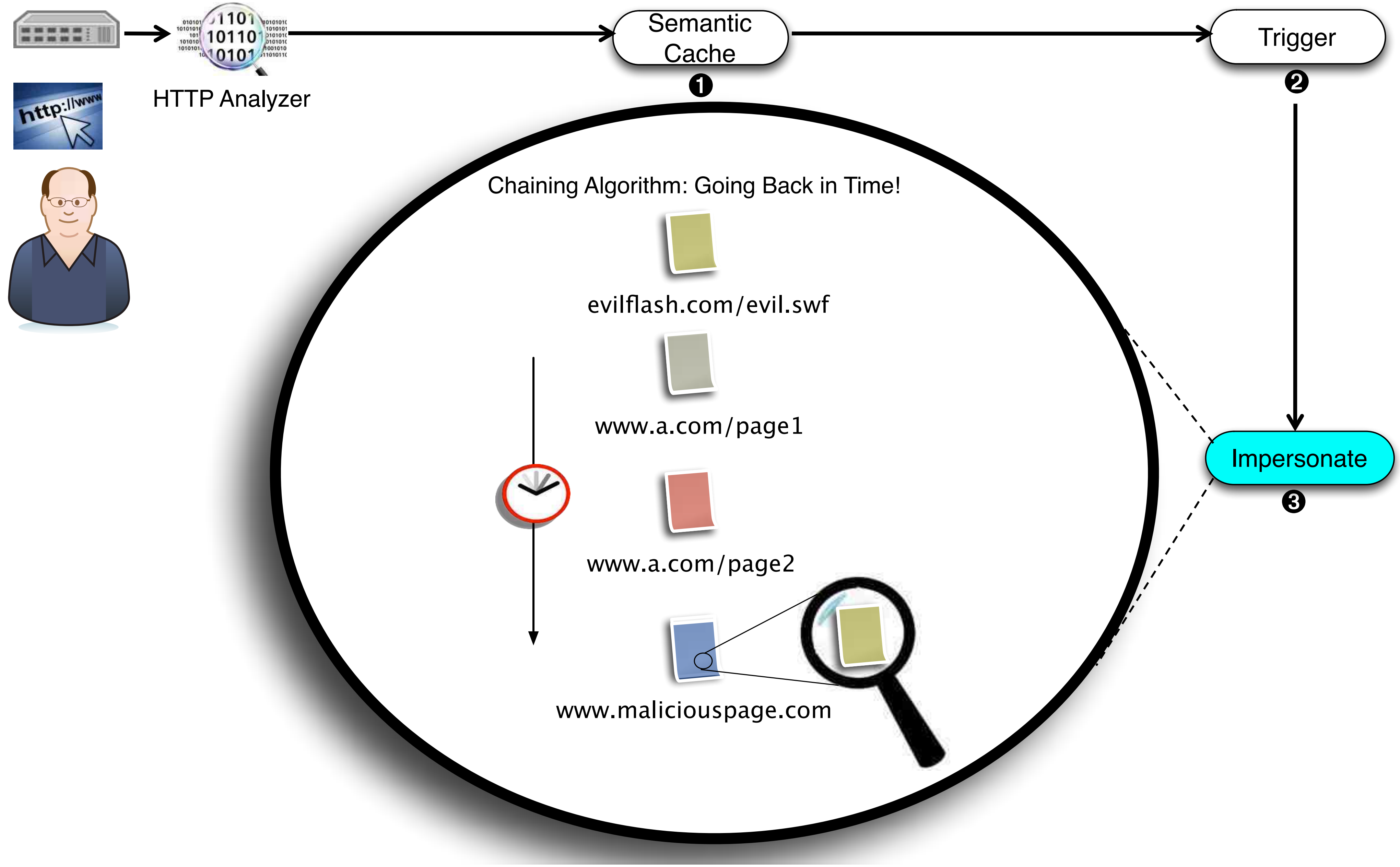
Retrieve Client Configuration

evilflash.com/evil.swf

Network Client IP:
192.168.2.30

Browser: IE 10
Flash Version: 18.5
OS: Windows 7

IMPERSONATE



HTTP Analyzer

Semantic Cache

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Trigger

❷

Impersonate

❸

Chaining Algorithm: Going Back in Time!

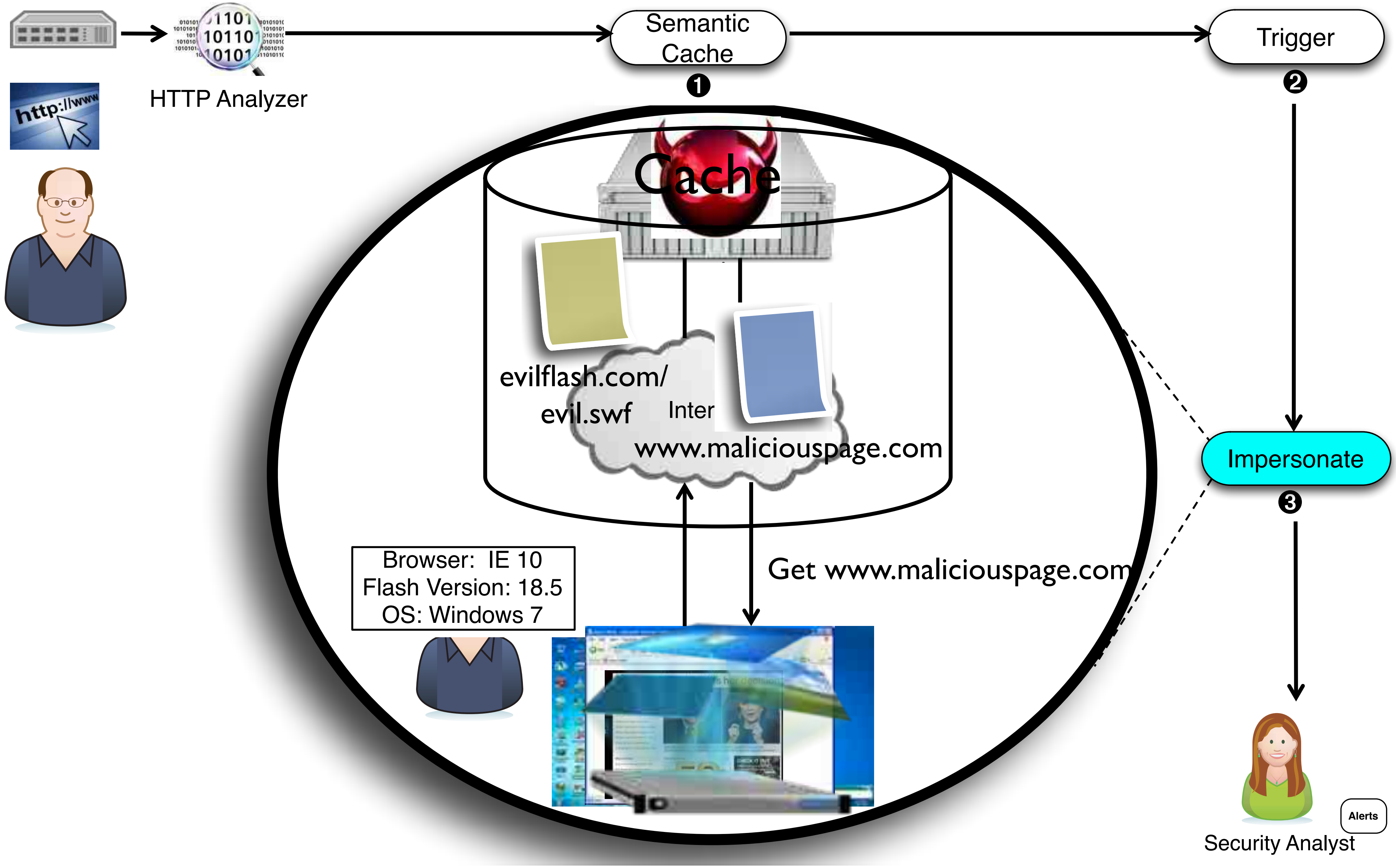
evilflash.com/evil.swf

www.a.com/page1

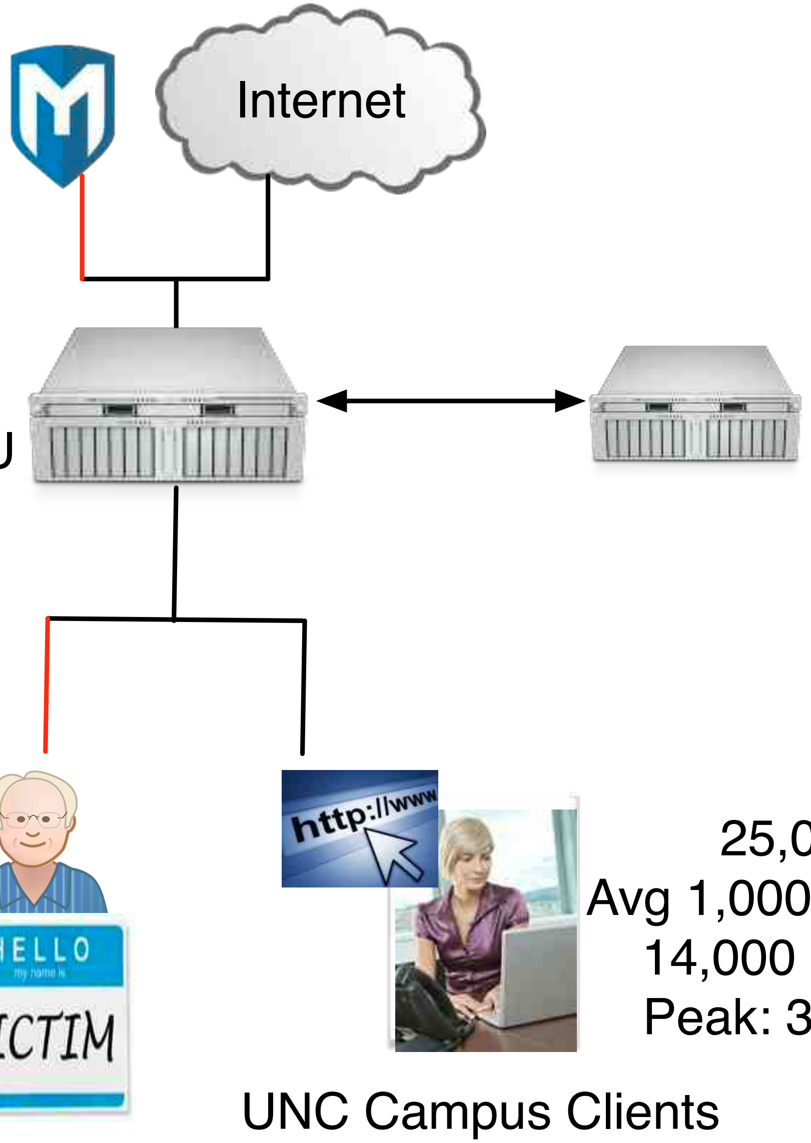
www.a.com/page2

www.maliciouspage.com

IMPERSONATE



Evaluation - Campus



Metasploit Server
Serves: 11 Flash exploits
Affects: 3 Flash Versions

Internet

Dell R410
128 GBs RAM
8 Core Xeon 2100 CPU
EndaceDAG Card

ShellOS: 5 VMs
Chrome, IE, Firefox
Headless Browser: HTMLUnit

Windows 7
Firefox/IE
3 Flash Versions

25,000 Students
Avg 1,000 Concurrent Users
14,000 HTTP flows/min
Peak: 35,000 flows/min

UNC Campus Clients

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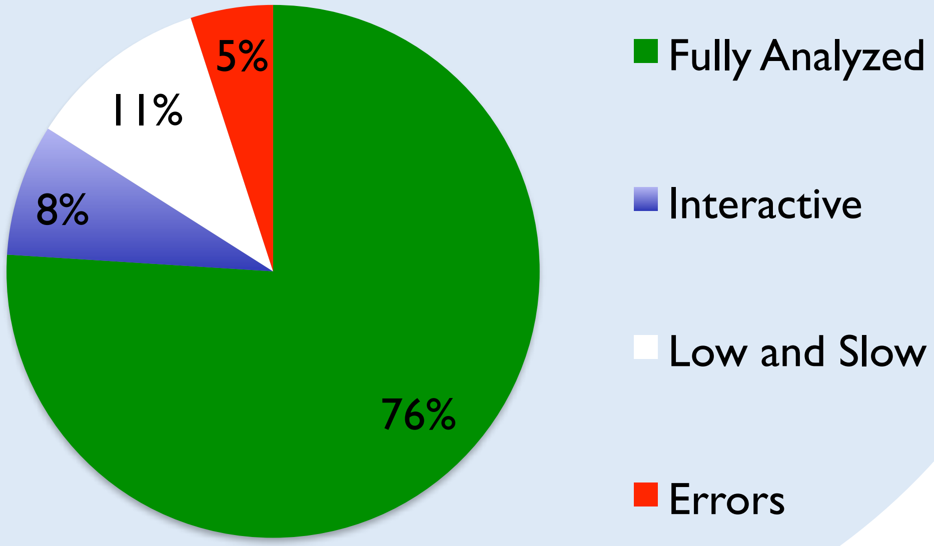
Evaluation – Results

Total: 576,000

Filtered: 99% of Flash Files.



- Found on avg 2 malicious sites per day

Conclusion: Honeyclient to the Wire

- Current network-based approaches are too slow to react.
- We propose a framework that:
  - Caches minutes worth of web objects.
  - Triggers an analysis on exploitable file types.
  - Impersonates both the client and the server.
- Demonstrated utility on a large campus network.

Questions?

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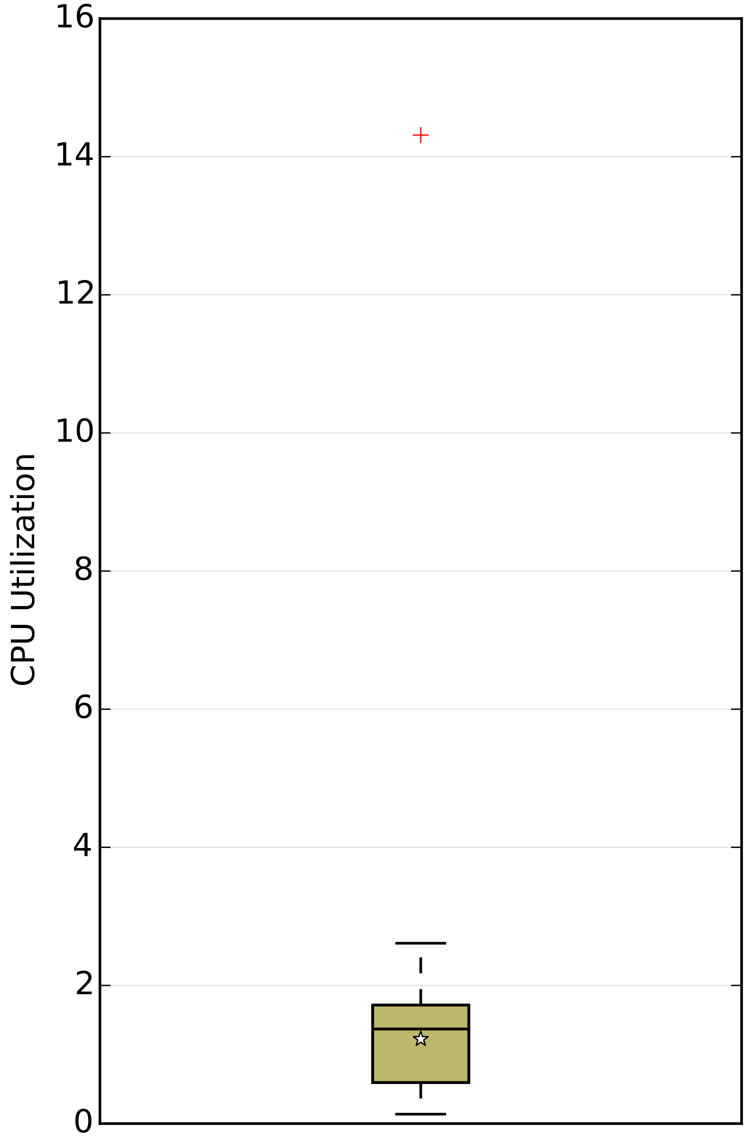
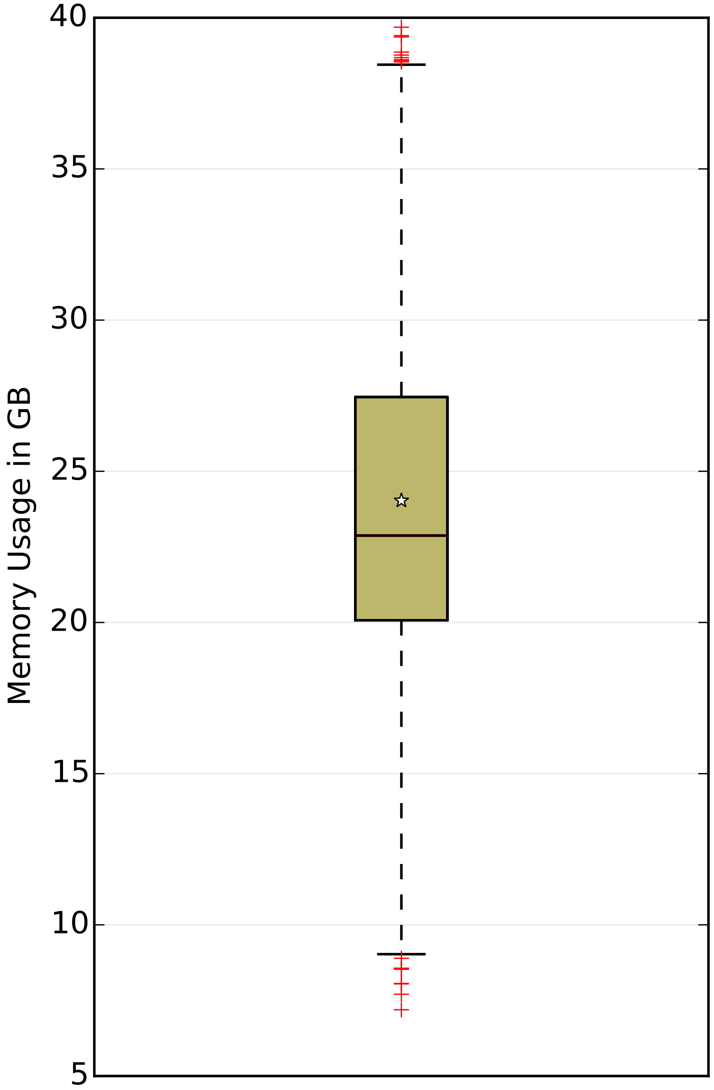
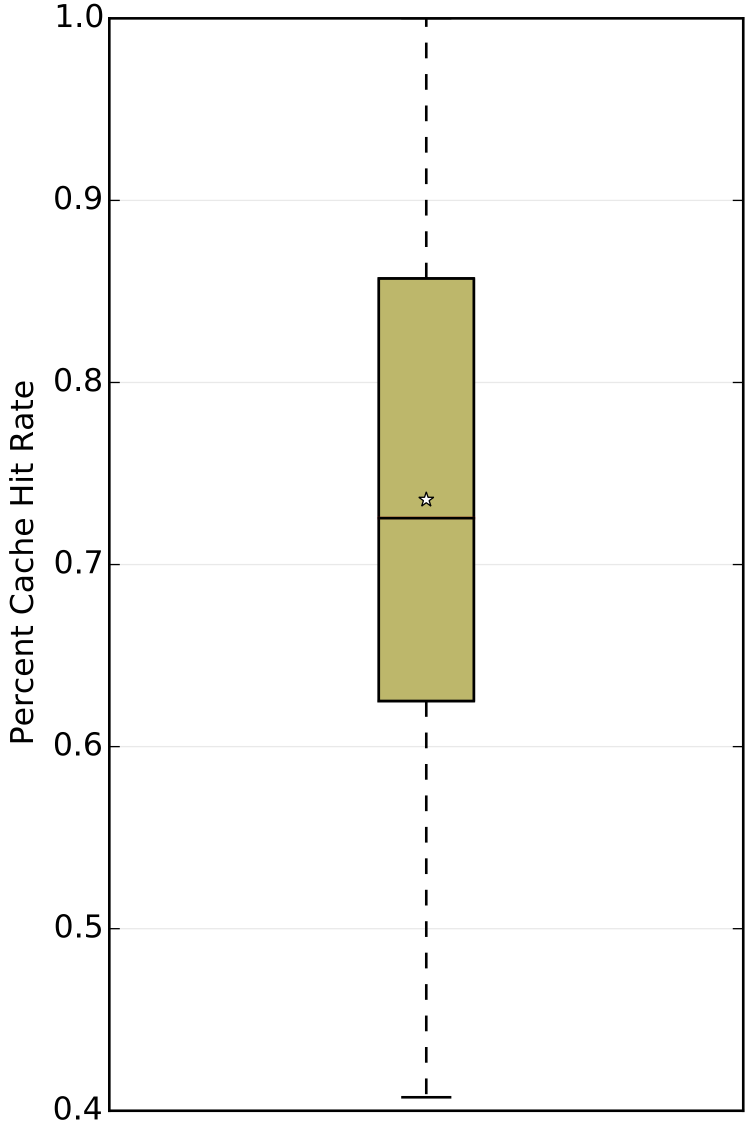
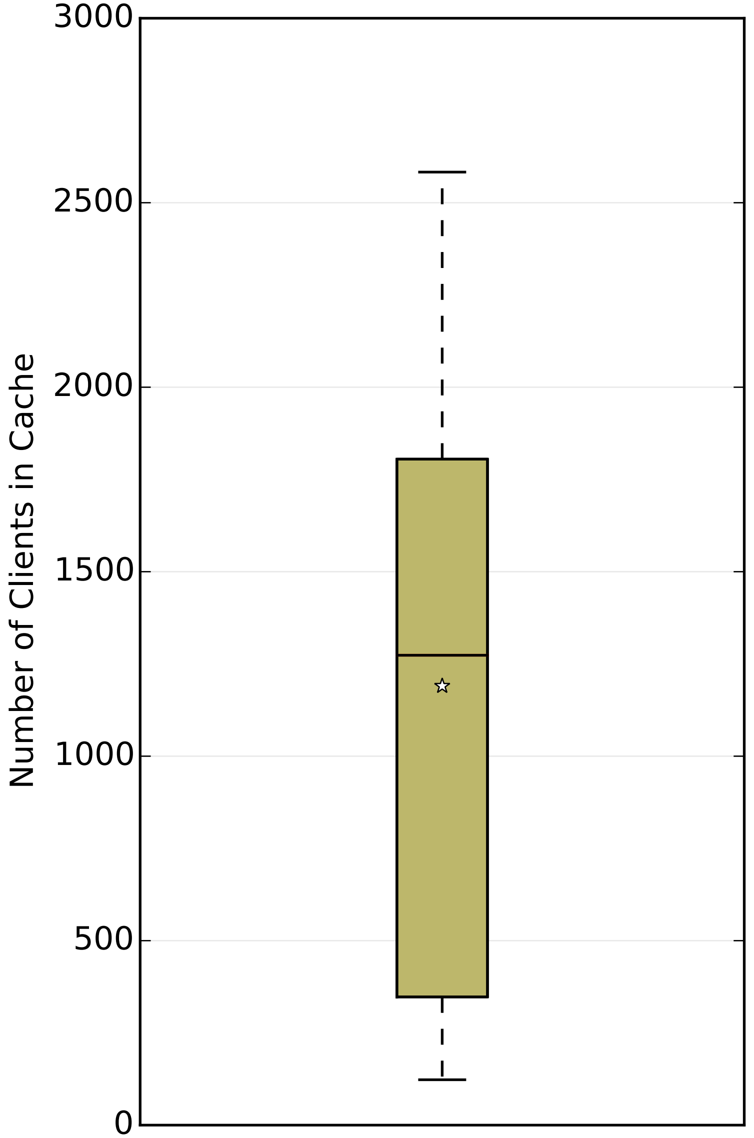
Evaluation – Performance



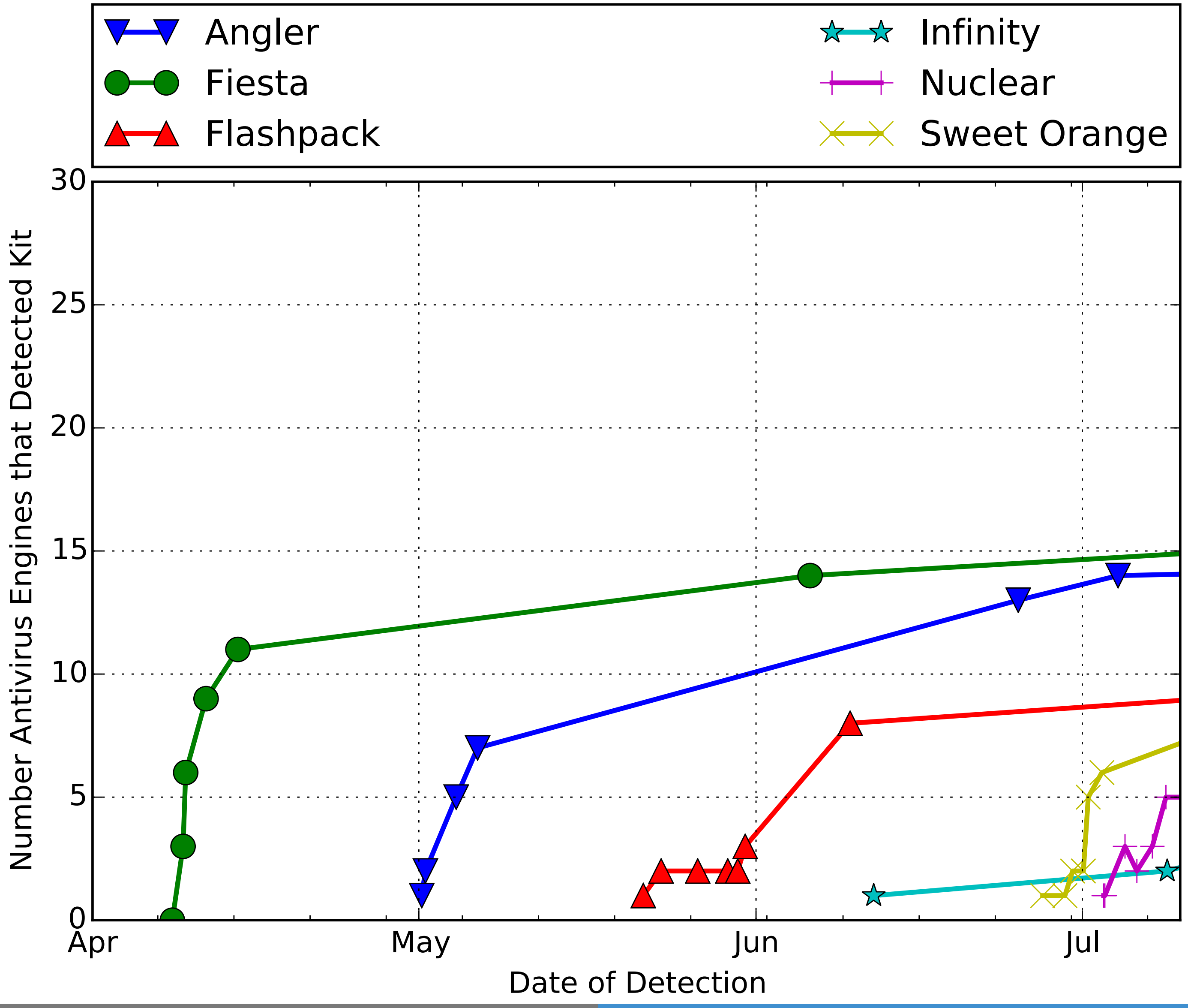


Evaluation – Cache

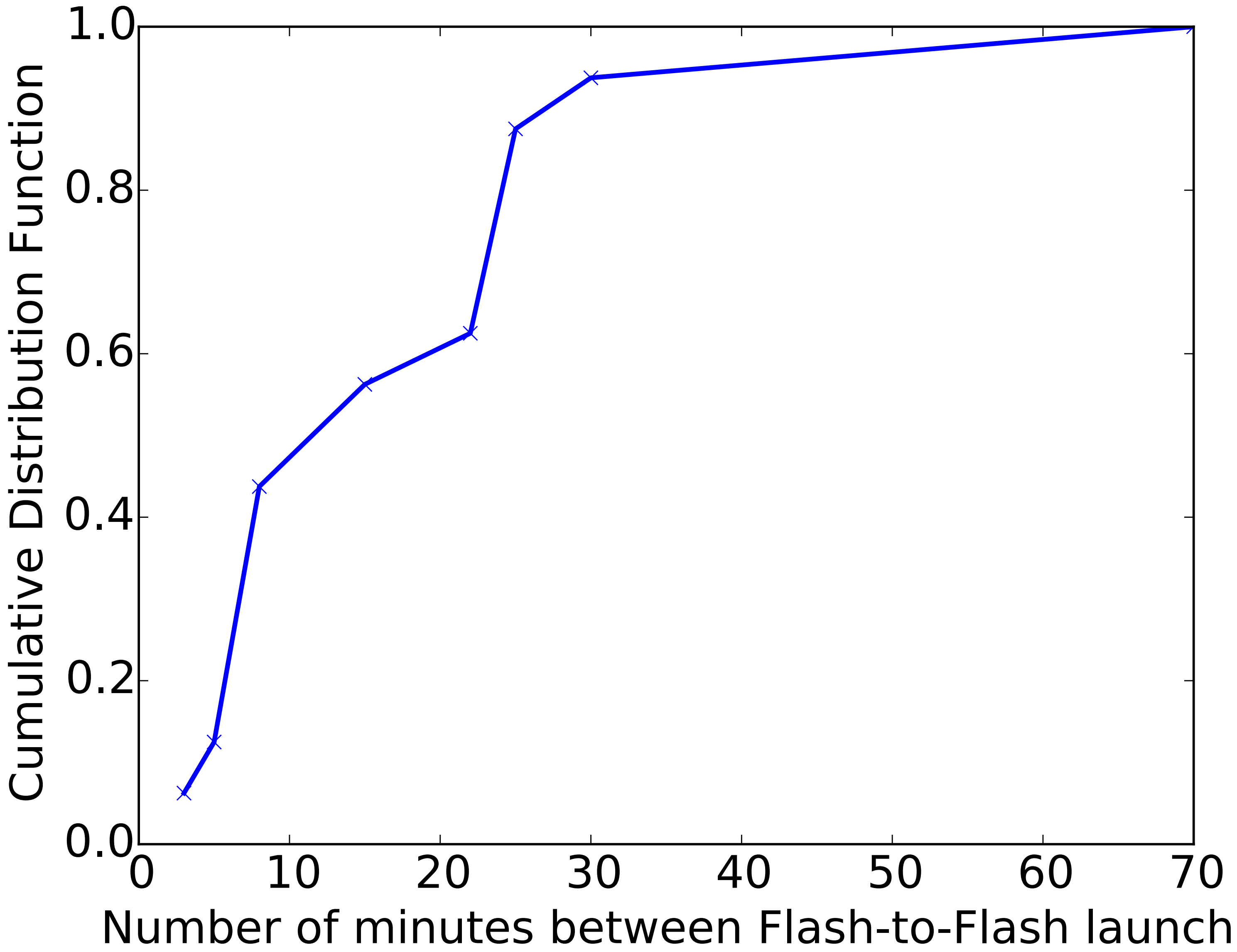




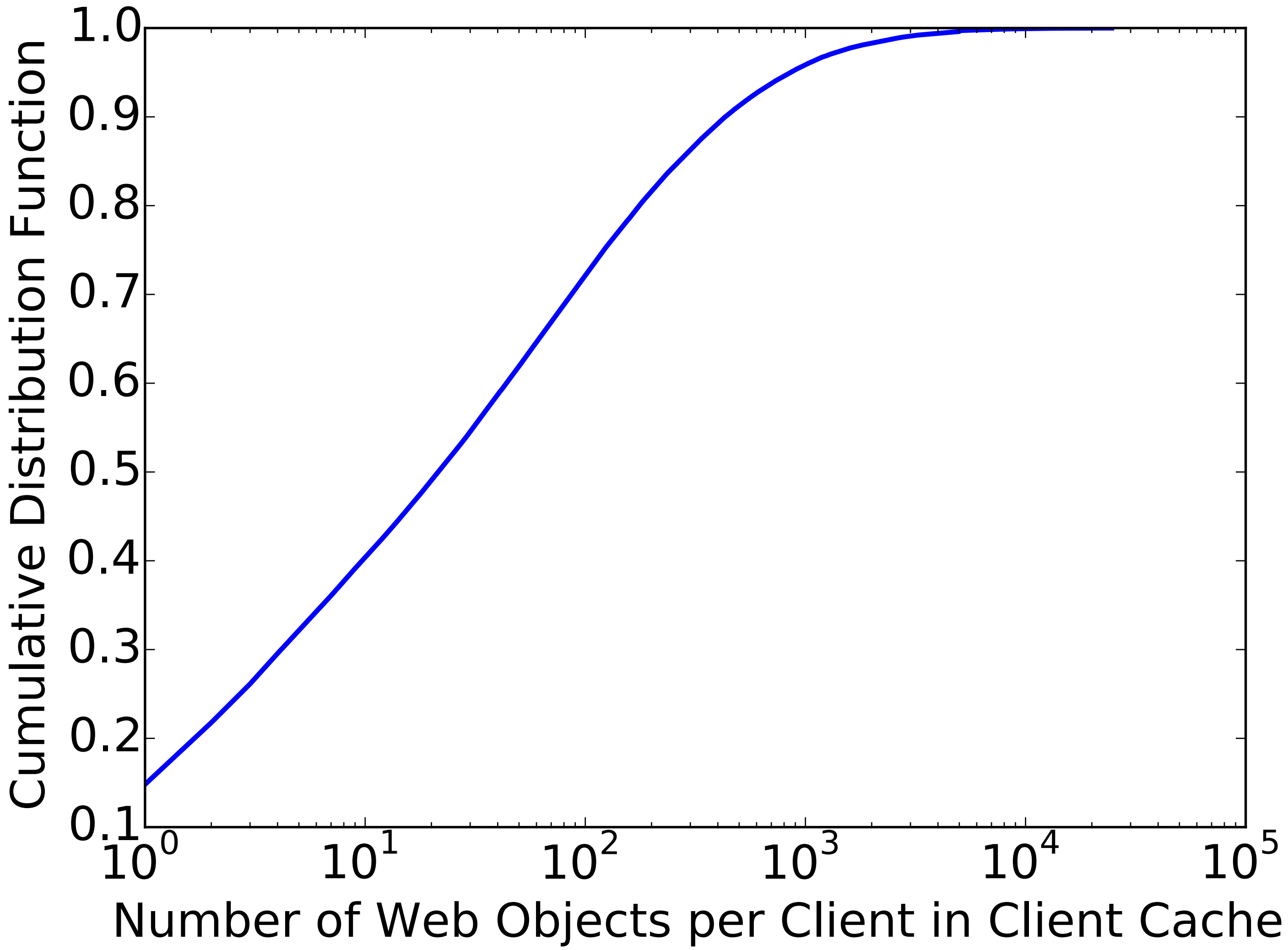
Evaluation – VirusTotal over Time



Evaluation – Minutes between Flash-in-Flash



Evaluation – Length of Client Cache



❹ Honeyclients

- Honeyclient H1 (ShellOS):
  - Process contains code injection/code reuse payload.
  - Process memory exceeds tunable threshold – heap spray.
  - Process terminates or crashes.

(Snow et. al, ShellOS: Enabling Fast Detection and Forensic Analysis of Code Injection Attacks, USENIX Security, 2011.)

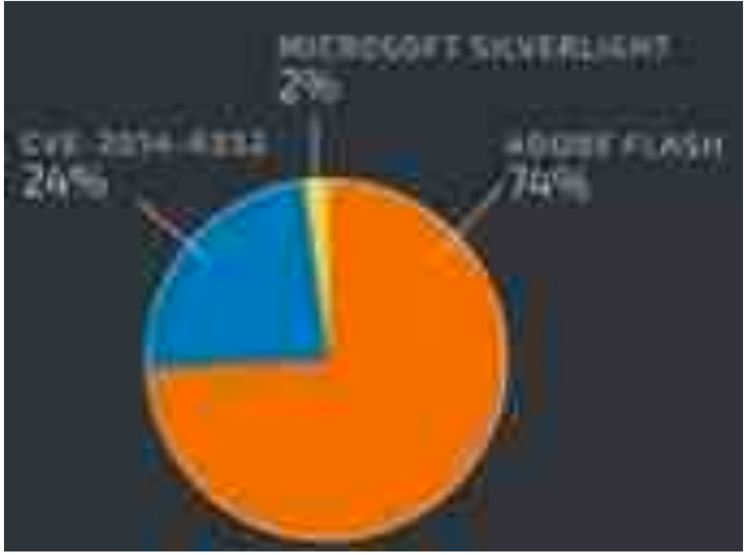
❹ Honeyclients

- Honeyclient H2 (Cuckoo Sandbox):
  - Process uses known anti-detection technique.
  - Process spawns another process.
  - Process downloads exe or dll file.
  - Process accesses registry or system files.

(https://cuckoosandbox.org/)

Exploit Kits – Corporate Ownage as a Service

The Angler Exploit Kit Exposed: Making $60 Million Annually by Delivering Ransomware



Targeted Victims / day: 90,000

Exploits Served Per Day: 9,000

Successful Infections: 40%

Ransomware Delivered: 62%

- Cisco Talos Group: http://www.talosintel.com/angler-exposed/
- October 2015

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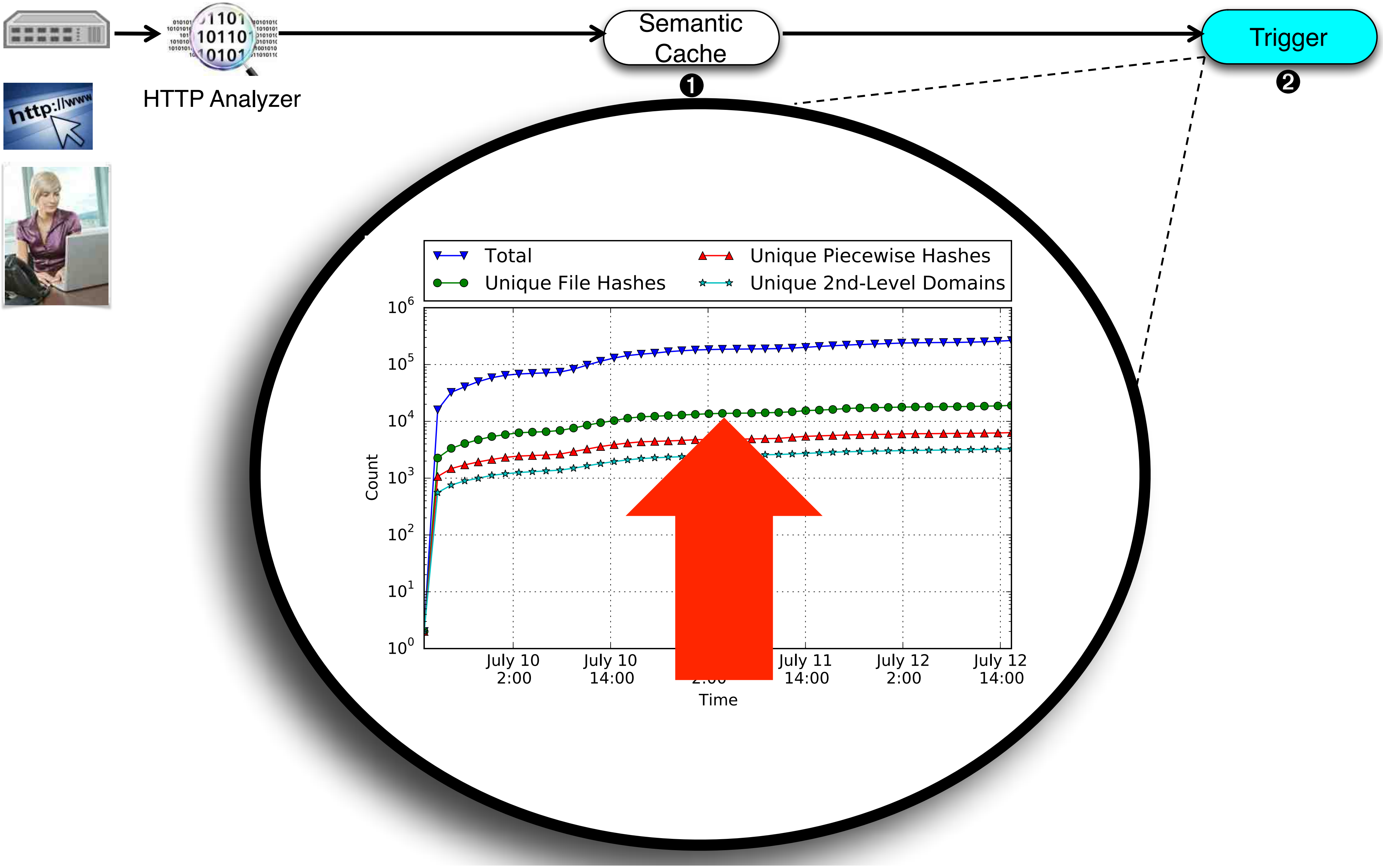
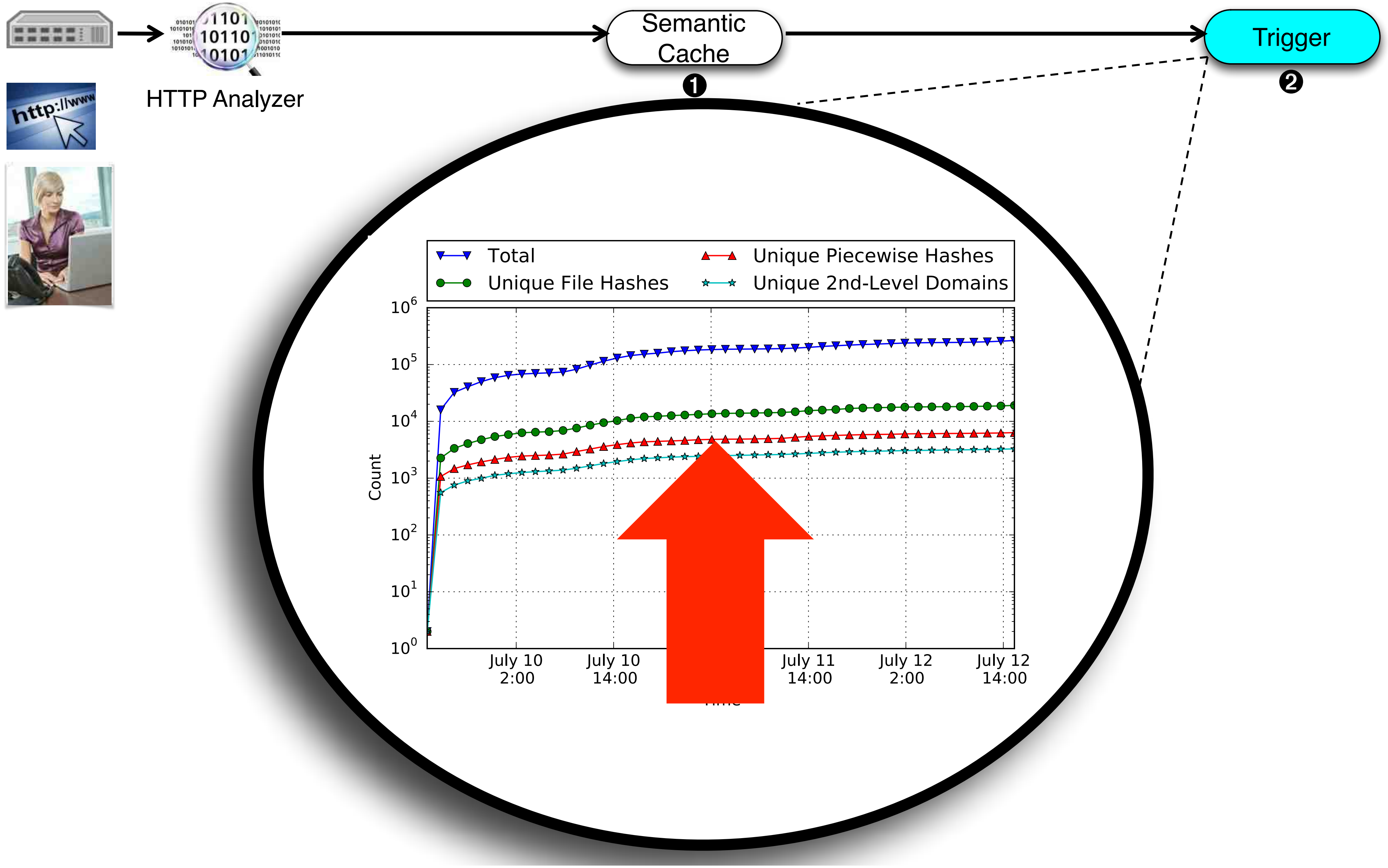
Impact of File Hashing



Impact of Piecewise Hashing



HTTP Analyzer

Semantic Cache

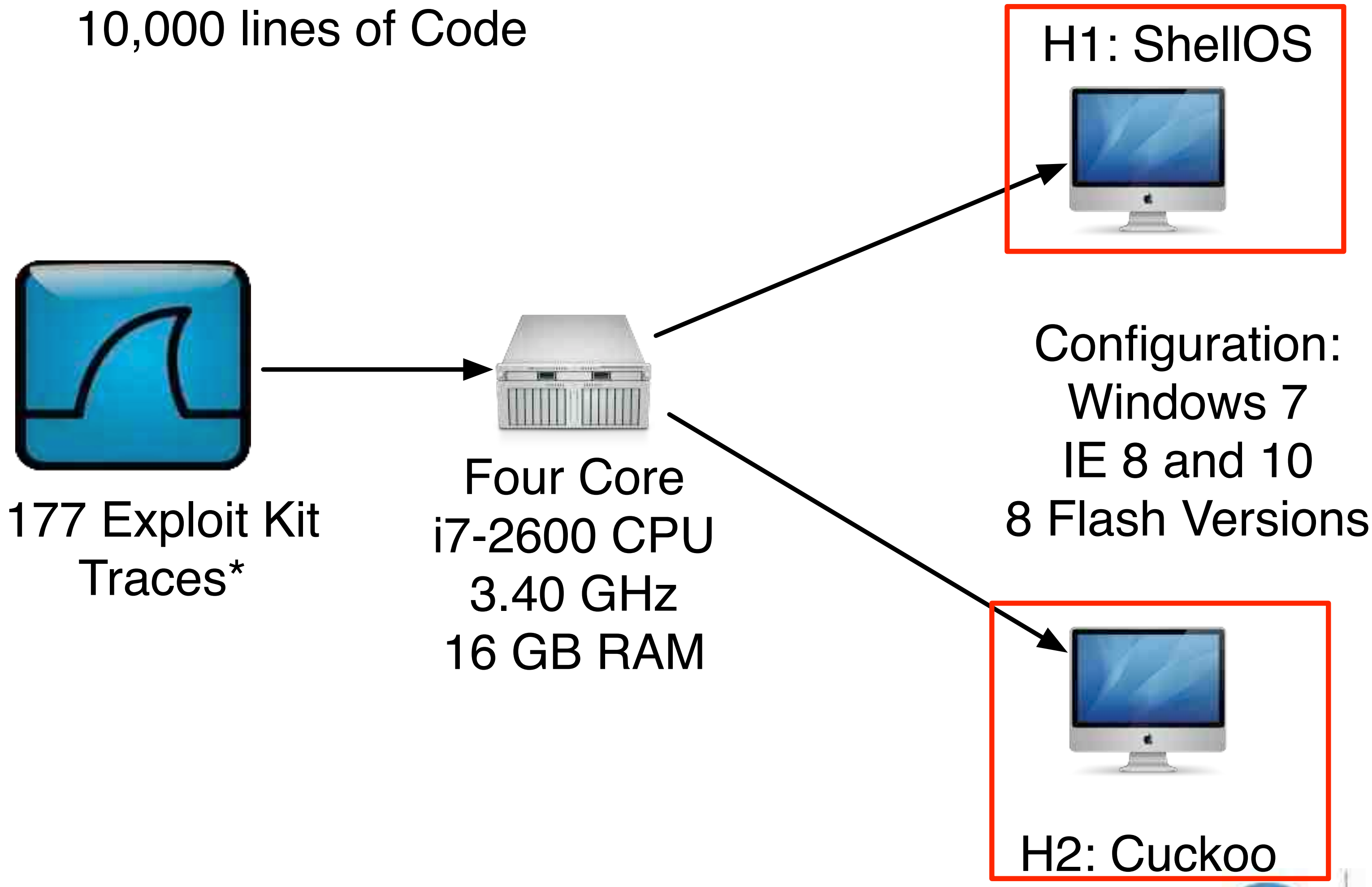
❶

Trigger

❷

Evaluation – Detection Performance

Prototype:
10,000 lines of Code



177 Exploit Kit
Traces*

Four Core
i7-2600 CPU
3.40 GHz
16 GB RAM

H1: ShellOS

Configuration:
Windows 7
IE 8 and 10
8 Flash Versions

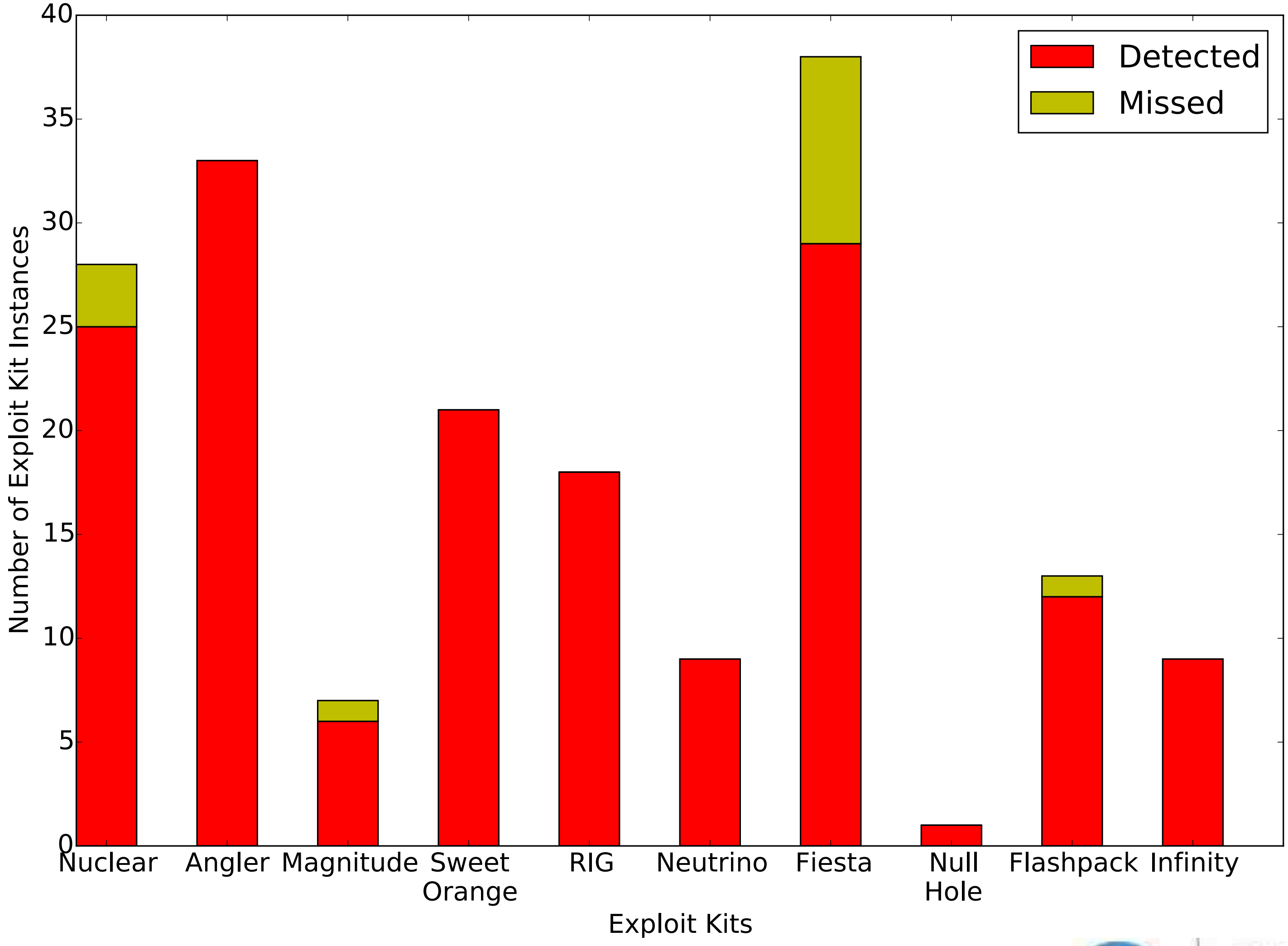
H2: Cuckoo

Monitors Code Injection/ Reuse.

Monitors OS Changes.

*www.malware-traffic-analysis.net

Evaluation – H1 Results



92% True Positive Rate

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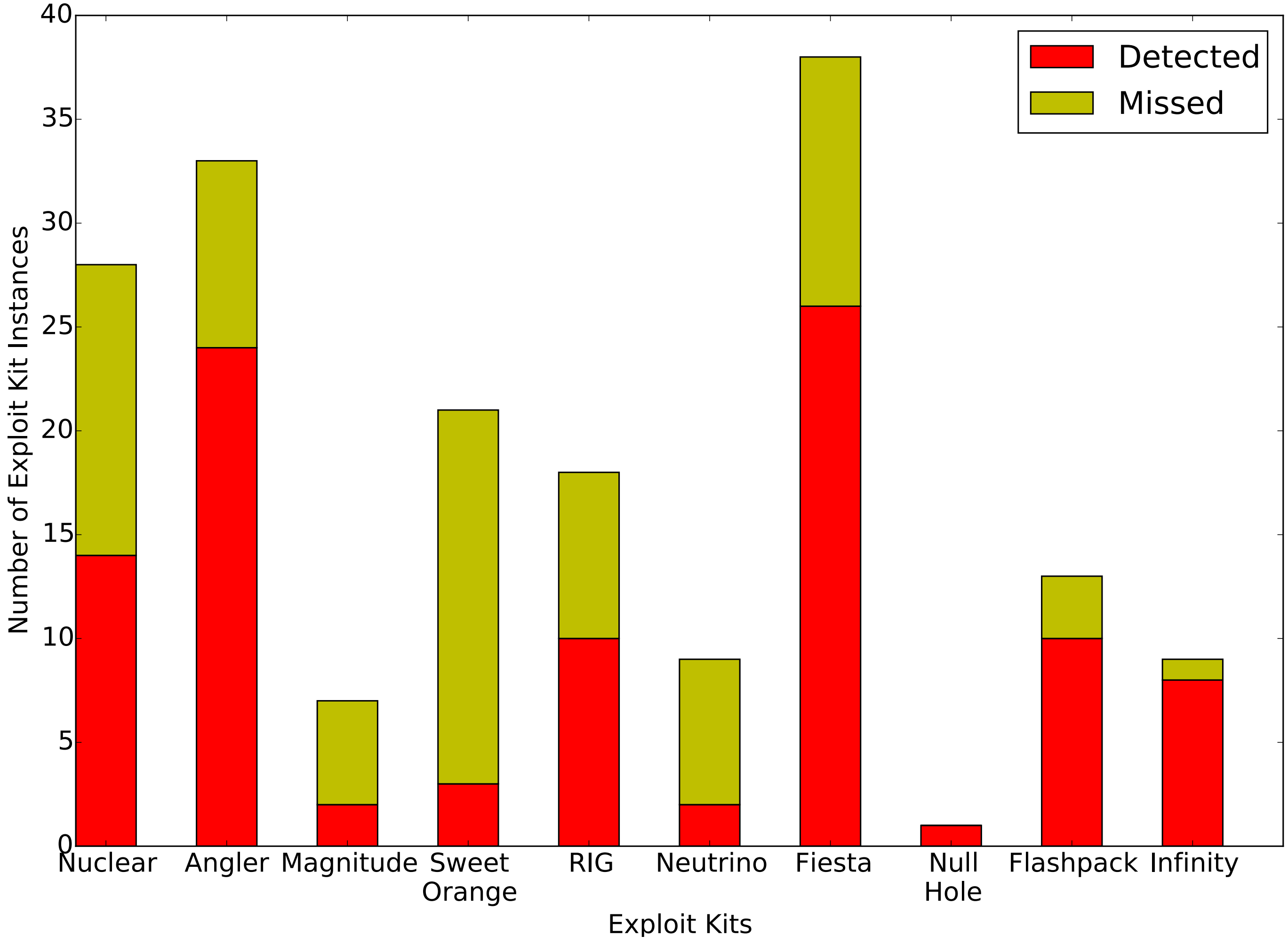
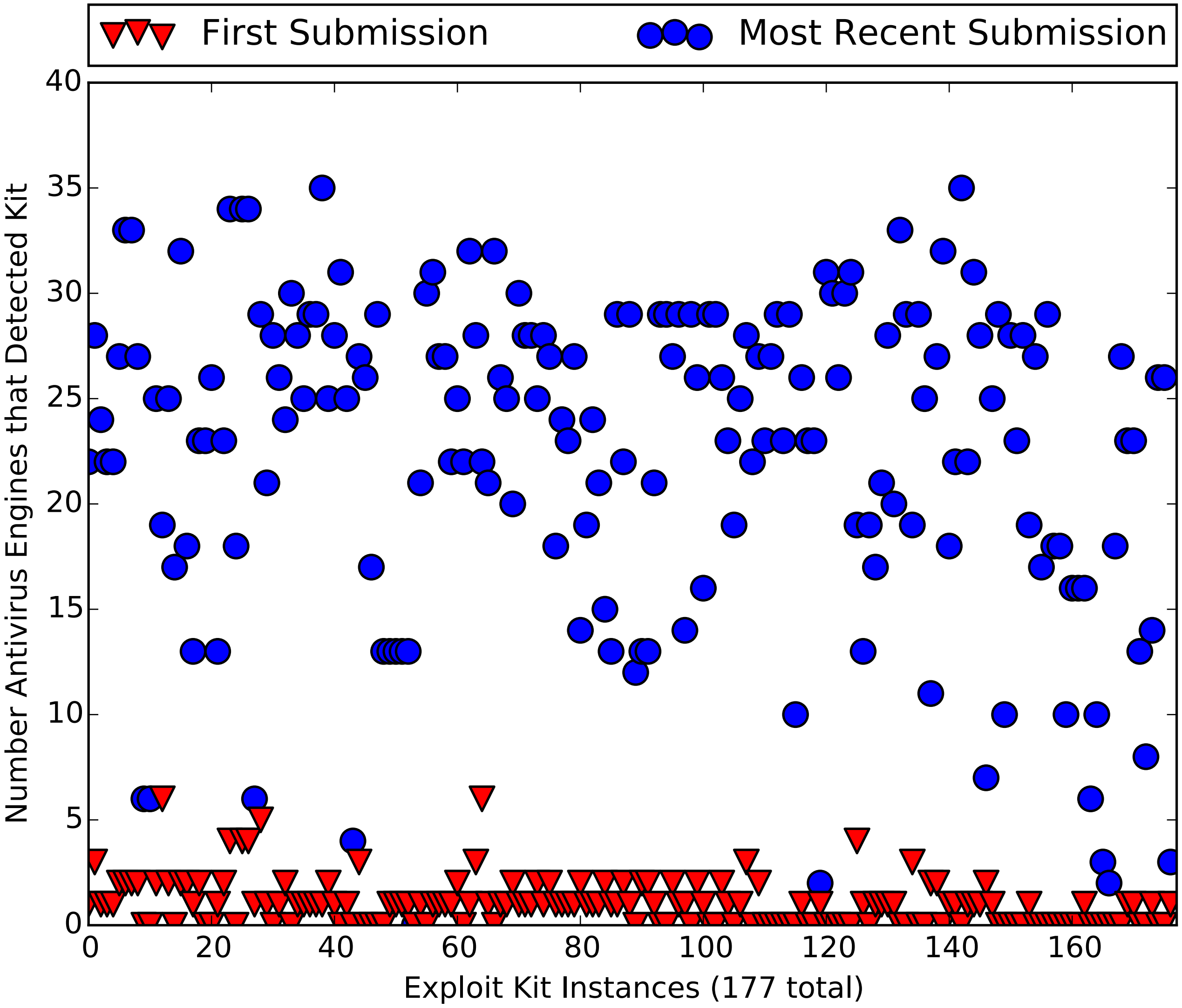
Evaluation – H2 Results



56% True Positive Rate

H1 & H2 Combined: 100% True Positive Rate

Evaluation – Comparison – VirusTotal



61 % True Positive Rate

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