mod_antimalware: a novel web server module for containing web-based malware infections

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www.dasient.com

Foundations of Security
What Every Programmer Needs to Know
Neil Daswani, Christoph Kern, and Anita Kesavan
Apress

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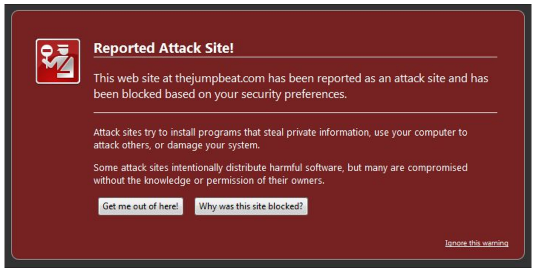
Web Malware Attacks Hurt Enterprises

Traffic and revenue loss

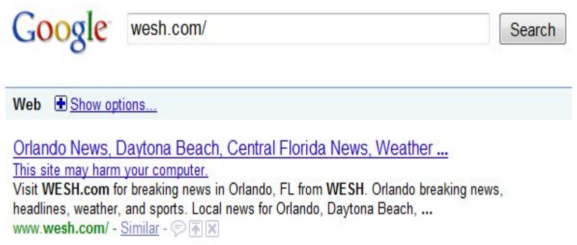


Reported Attack Site!

This web site at thejumpbeat.com has been reported as an attack site and has been blocked based on your security preferences.

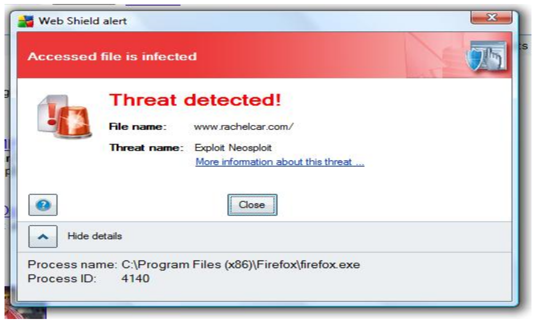
Attack sites try to install programs that steal private information, use your computer to attack others, or damage your system.

Some attack sites intentionally distribute harmful software, but many are compromised without the knowledge or permission of their owners.



Orlando News, Daytona Beach, Central Florida News, Weather ...
This site may harm your computer.
Visit WESH.com for breaking news in Orlando, FL from WESH. Orlando breaking news, headlines, weather, and sports. Local news for Orlando, Daytona Beach, ...
www.wesh.com/ - Similar

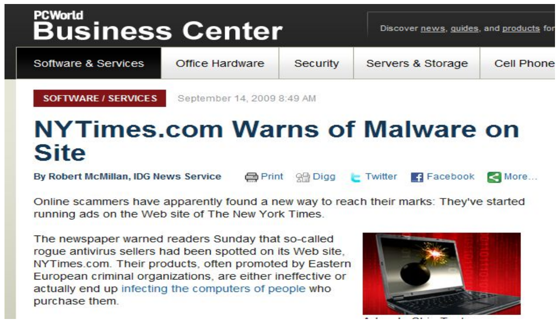
Brand and customer loss



Threat detected!

File name: www.rachelcar.com/
Threat name: Exploit Neosploit
More information about this threat ...

Process name: C:\Program Files (x86)\Firefox\firefox.exe
Process ID: 4140



September 14, 2009 8:49 AM

NYTimes.com Warns of Malware on Site

By Robert McMillan, IDG News Service

Online scammers have apparently found a new way to reach their marks: They've started running ads on the Web site of The New York Times.

The newspaper warned readers Sunday that so-called rogue antivirus sellers had been spotted on its Web site, NYTimes.com. Their products, often promoted by Eastern European criminal organizations, are either ineffective or actually end up infecting the computers of people who purchase them.

Data Theft/ Compliance Liability

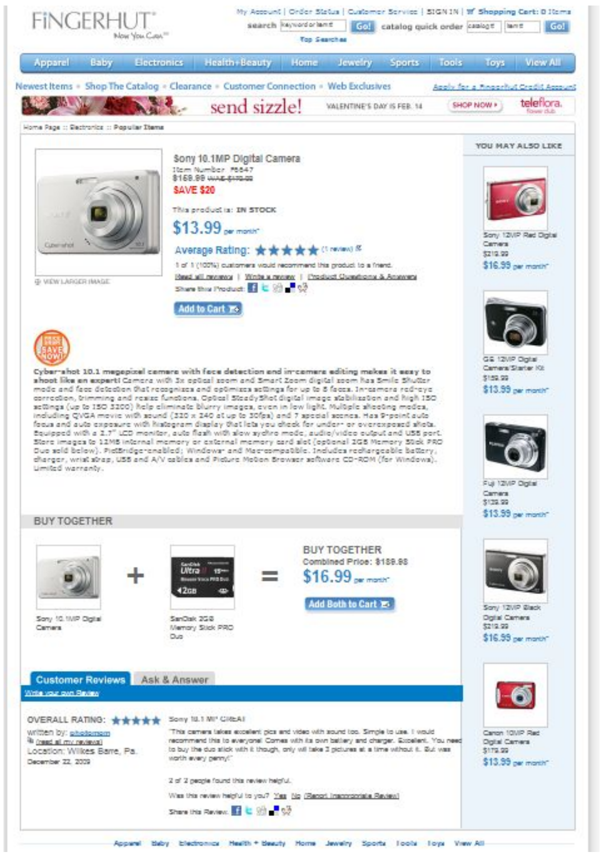
The Challenge for Websites: Many Ways to Get Infected

Web 2.0/ external content

- Mash-ups
- Widgets
- External images
- User generated content (HTML, images, links, exe, documents)
- Third-party ads

Software vulnerabilities

- SQL injection
- XSS
- PHP file include
- Unpatched Software (blog, CMS, shopping cart, web server, PHP, Perl)



Passwords compromised

- FTP credentials
- SSH credentials
- Web server credentials

Infrastructure vulnerabilities

- Vulnerable hosting platform
- Network vulnerabilities

“Structural” Vulnerabilities

A structural vulnerability is:

a weakness in a web page that may allow an attacker to compromise the entire page as a result of the reliance of the page design on a page component, where the compromise of the component can result in compromise of the entire page.

Examples

```
<script> … document.write(unescape(“%3Cscript
src=‘” + gaJsHost + “google-analytics.com/ga.js’ …
</script>

<script type=‘text/javascript’ src=‘jquery.js’ …

<iframe src=“http://ad.yieldmanger.com/iframe?...
%26search%3D%5Bterms%5D%26ip%3D%5Bip
%5D%26ua%3D%5Bua%5D%26style
%3D2%26size%3D160x600,Z%3D160x600…
```

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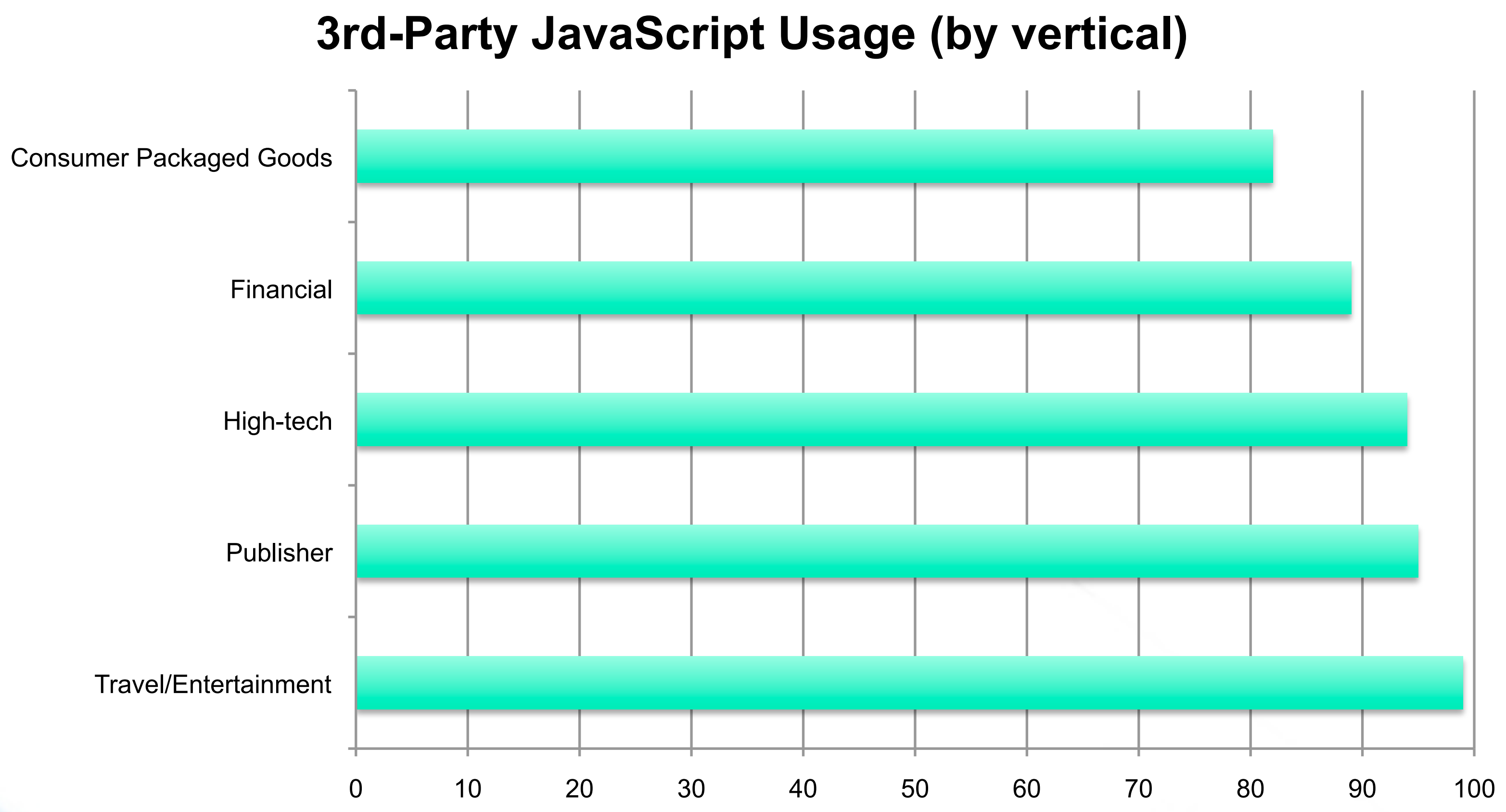
Structural Vulnerabilities: Stats

75% of web sites use third-party JavaScript widgets (analytics, UI, ads, etc)

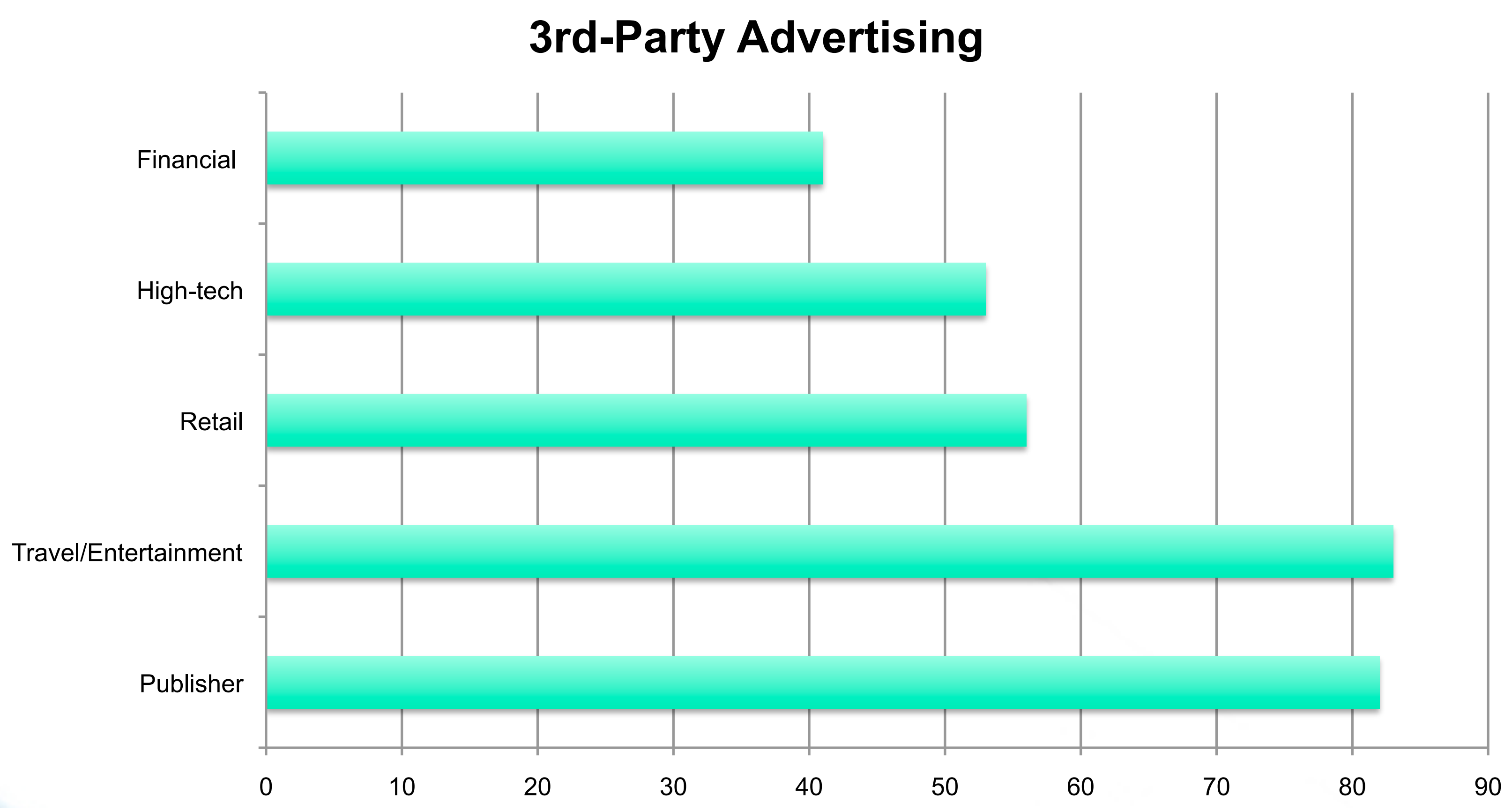
82% of publishers run third-party ads

91% of businesses have some outdated (vulnerable) third-party software powering their websites

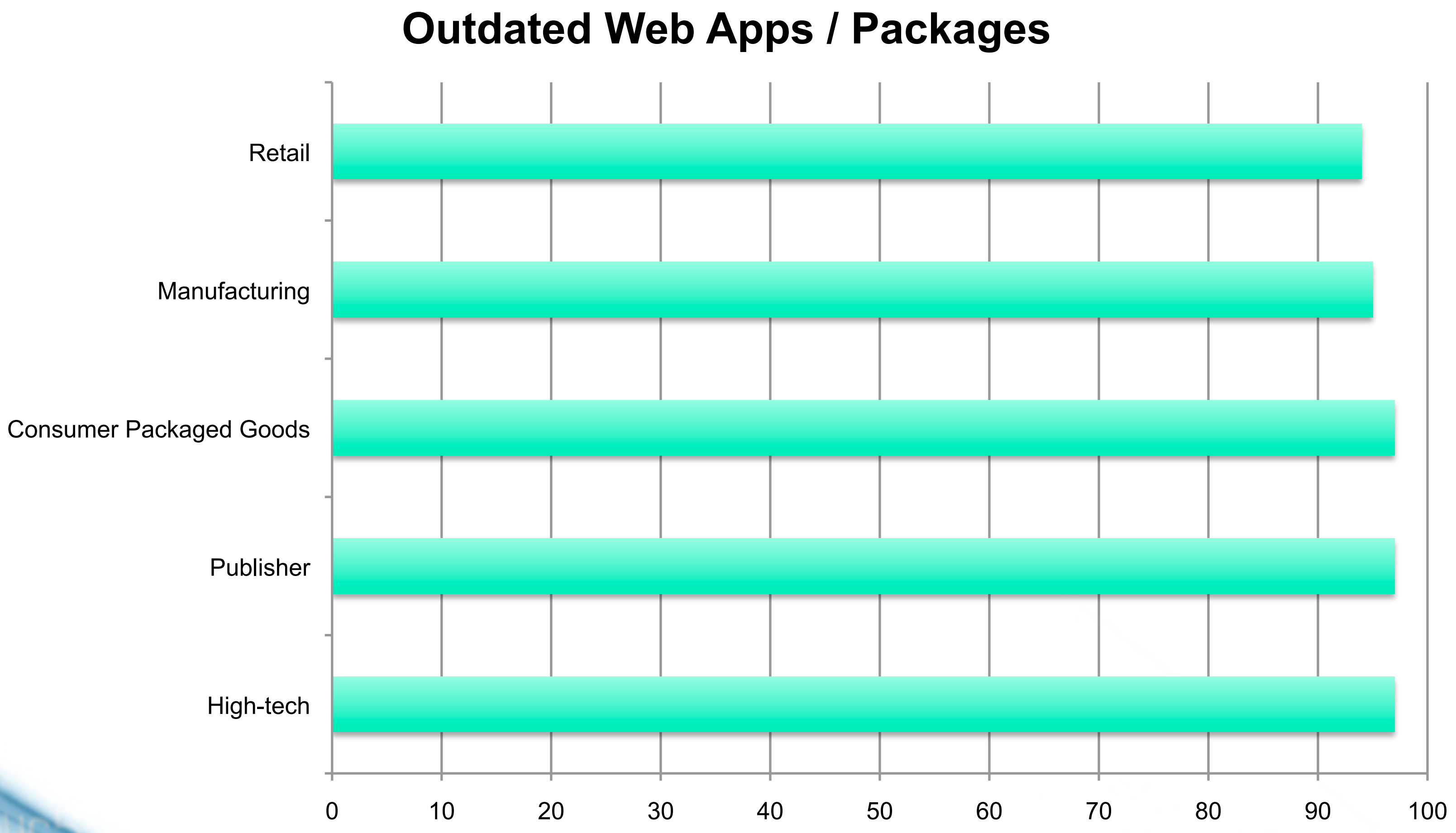
Structural Vulnerabilities: Stats



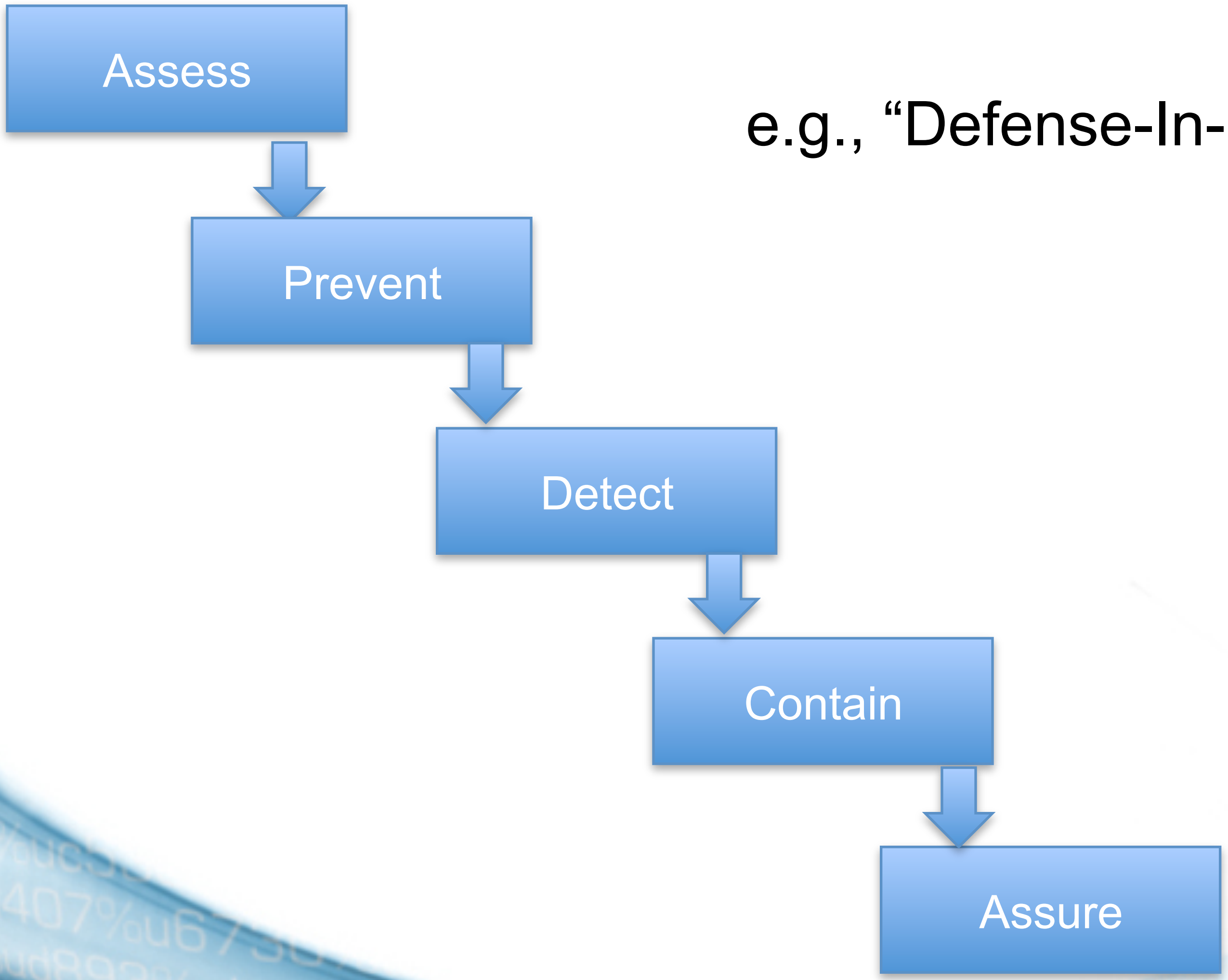
Structural Vulnerabilities: Stats



Structural Vulnerabilities: Stats



Problem: How to Provides the Complete Lifecycle of Malware Protection for Web Sites?



e.g., “Defense-In-Depth”

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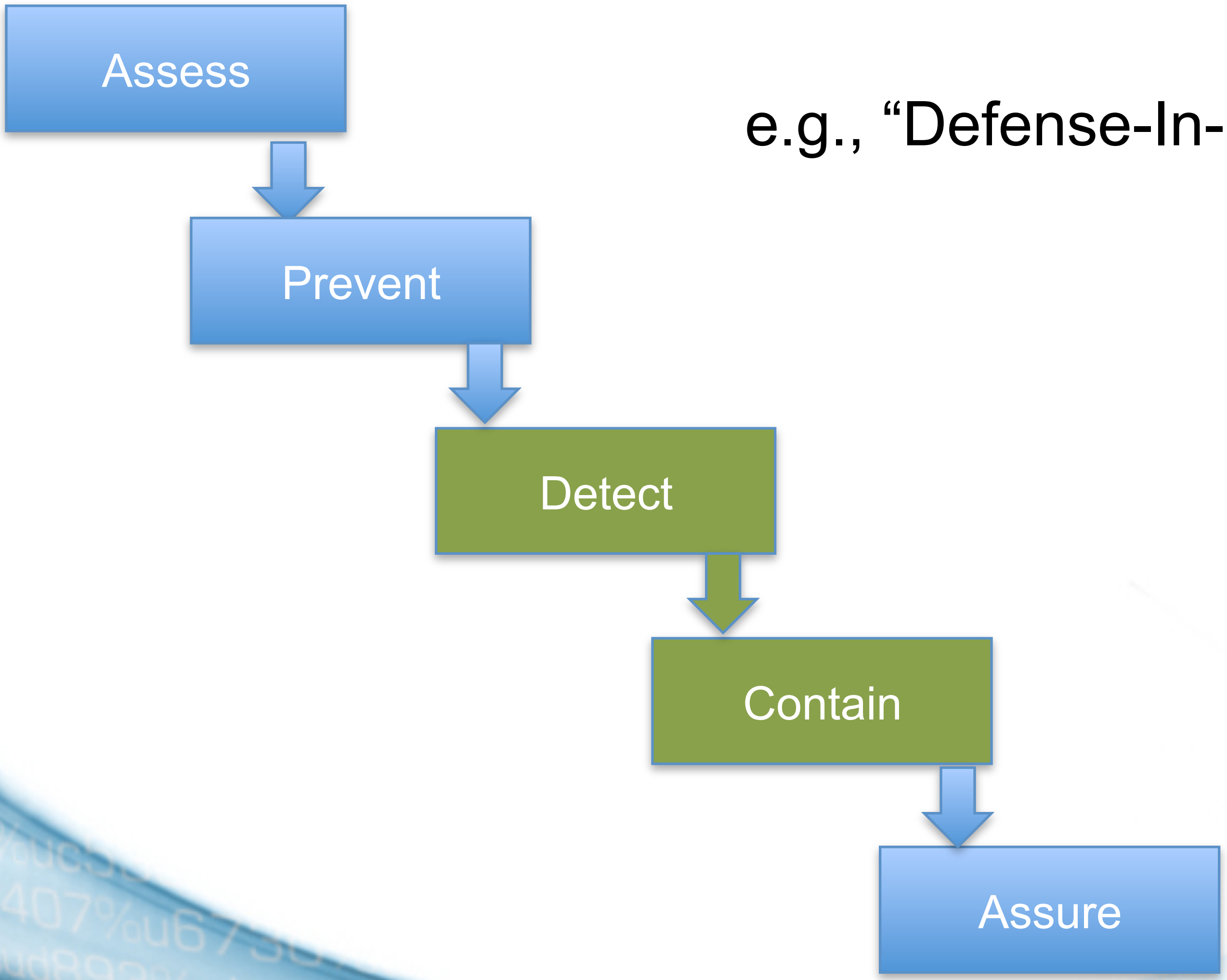
Problem: How to Provides the Complete Lifecycle of Malware Protection for Web Sites?



e.g., “Defense-In-Depth”

Why is protecting web sites from drive-bys hard?

Need to bring "lifecycle" of protection to the web

Need to "root cause" what code on the page caused the problem

Need to be able to parse page in real time and strip out infection. (Could be coming from anywhere—file, DB, etc)

Need to do so with high performance

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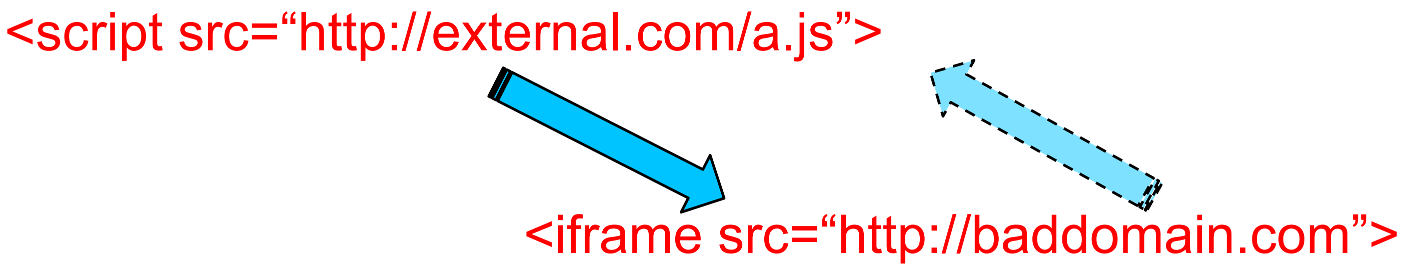
Solution: Detection & Containment

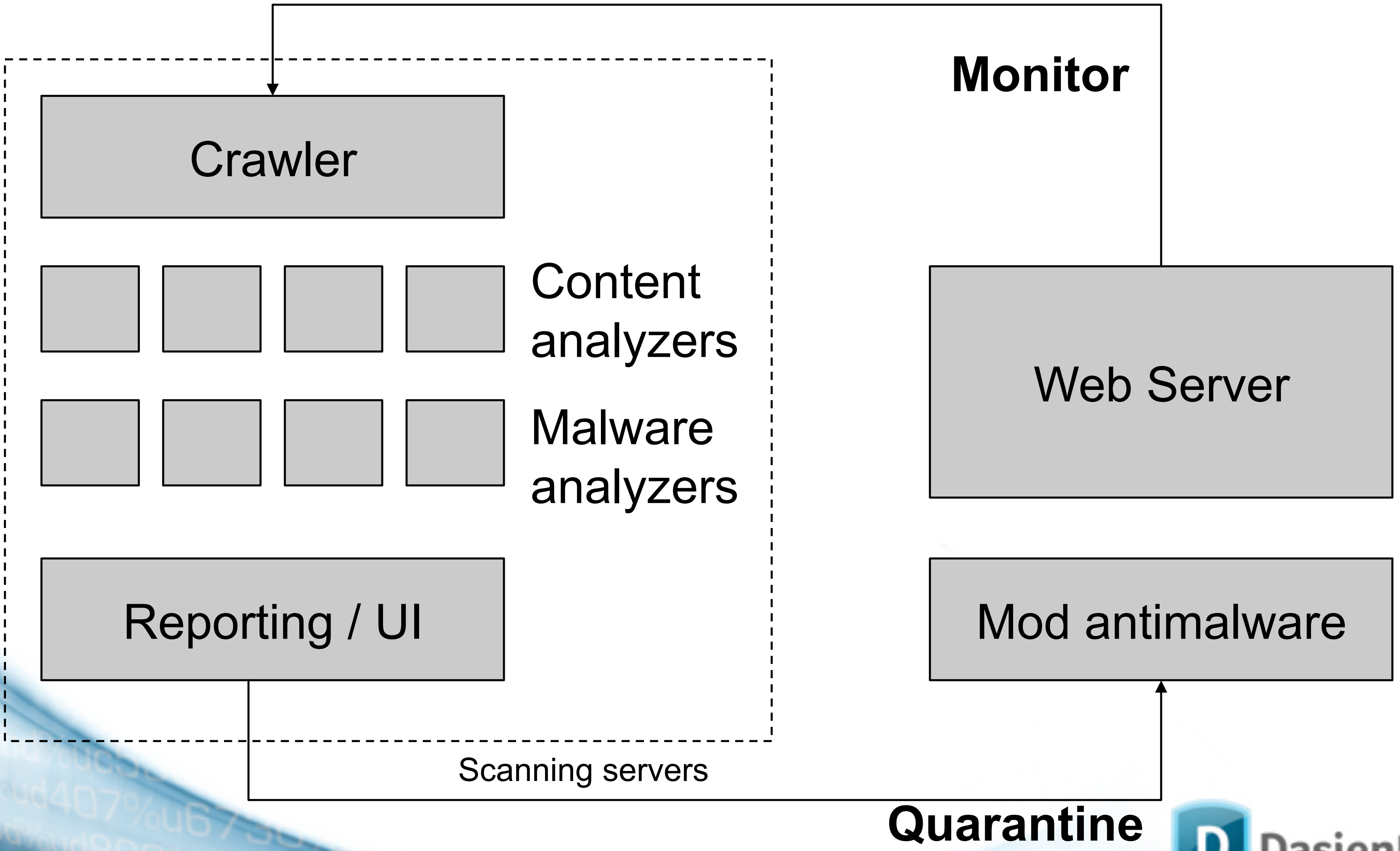
- Goal: Extract “root cause” of malcode



```
<script src=“http://external.com/a.js”>
<iframe src=“http://baddomain.com”>
```

- Detection
  - Behavioral Content Extraction (active scripts)
  - Lineage computation
  - Features / Signals Analysis

Mod_antimalware Architecture



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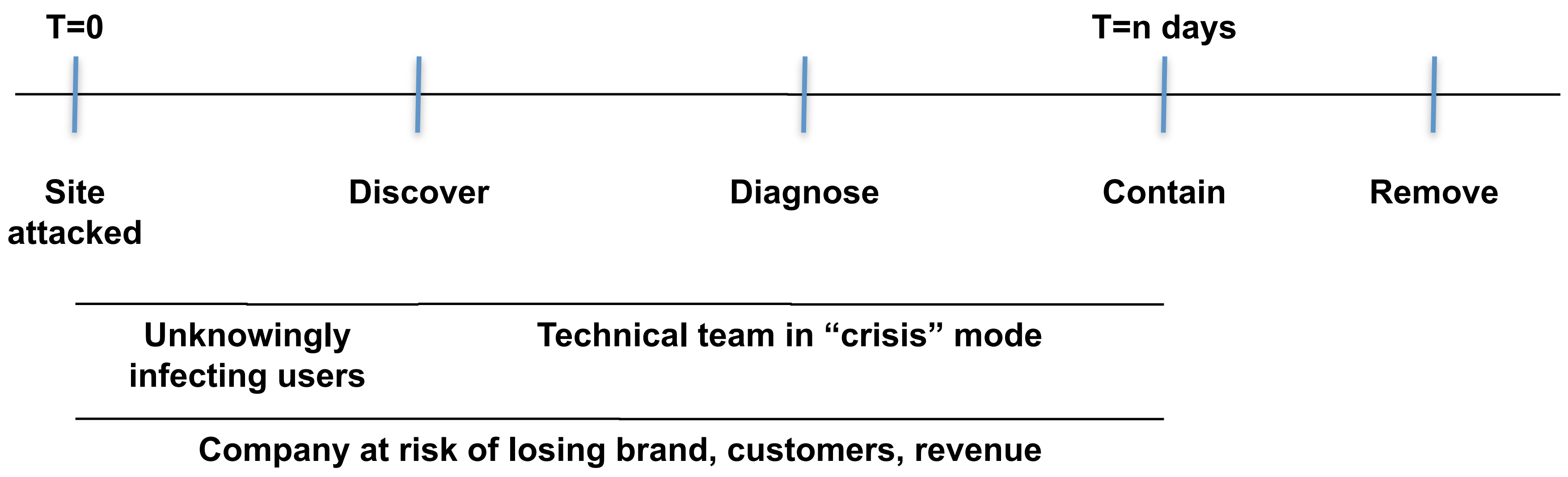
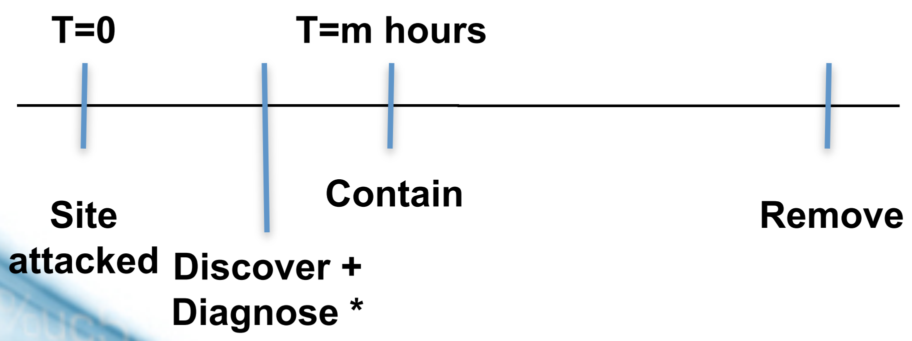
Without Mod_Antimalware


T=0
T=n days
Site attacked
Discover
Diagnose
Contain
Remove
Unknowingly infecting users
Technical team in “crisis” mode
Company at risk of losing brand, customers, revenue

With Mod_Antimalware



* - No time lag between Discover, Diagnose and Contain with Auto-Containment enabled

Significantly reduce reaction time (m hours << n days)

Mod_antimalware Architecture

Apache module (IIS also).
Output filter: main function is quarantine_filter().

Two versions: standard & lite (open-source)

Handlers:
- statusz: echo last config directives
- configz: modify config directives
- topz: echo most frequently accessed URLs

Mod_antimalware Configuration Directives

```
DasientSharedAuthKey your_key_goes_here

SetBlacklistRedirectMessage “This server is experiencing technical difficulties. Please come back later.”

BlacklistRedirectUrlPrefix /foo1.html
```
(e.g. quarantining directive)

```
RemoteDirectivesFile /etc/apache2/antimalware_remote_directives.conf
```

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Mod_antimalware Architecture

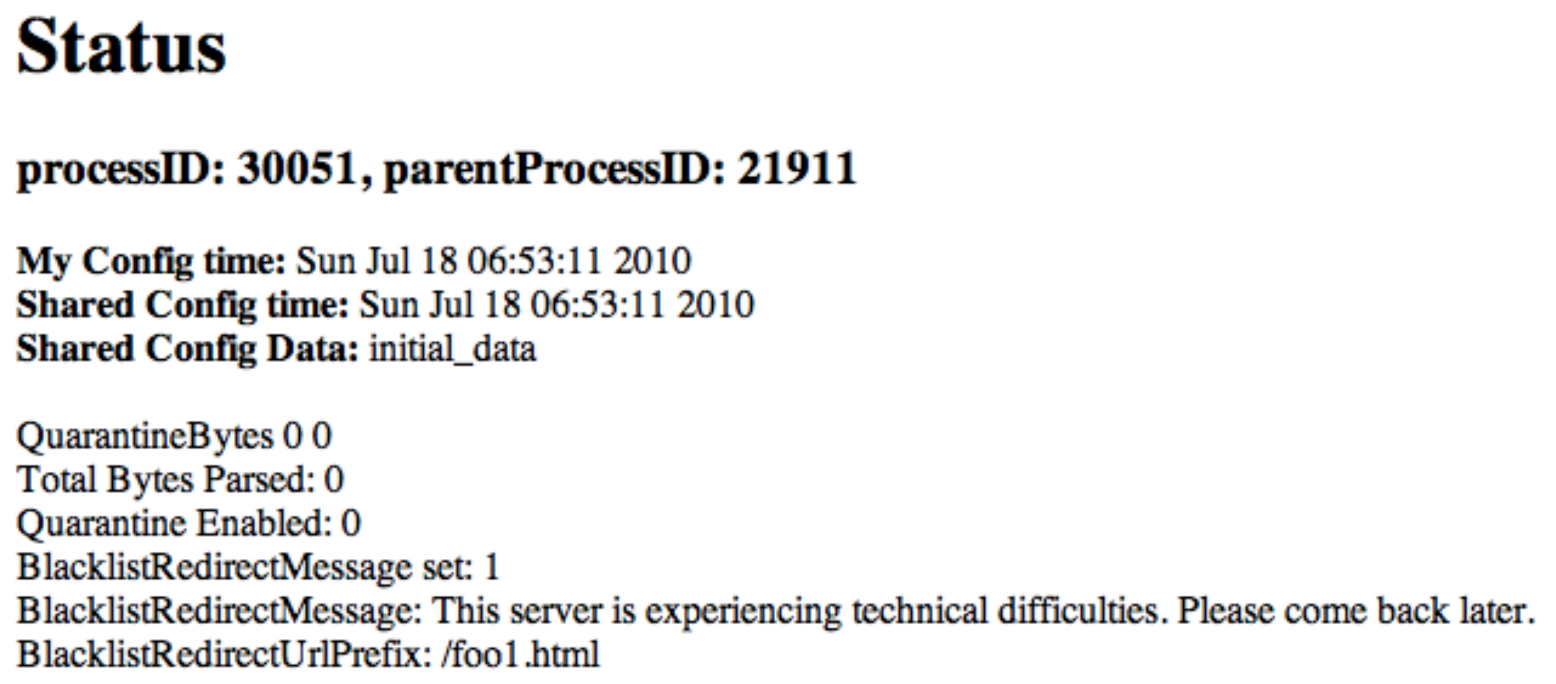
Quarantining Directives:

Blocking (mod_antimalware_lite)

vs.

Filtering (mod_antimalware)

Mod_antimalware Architecture: /statusz



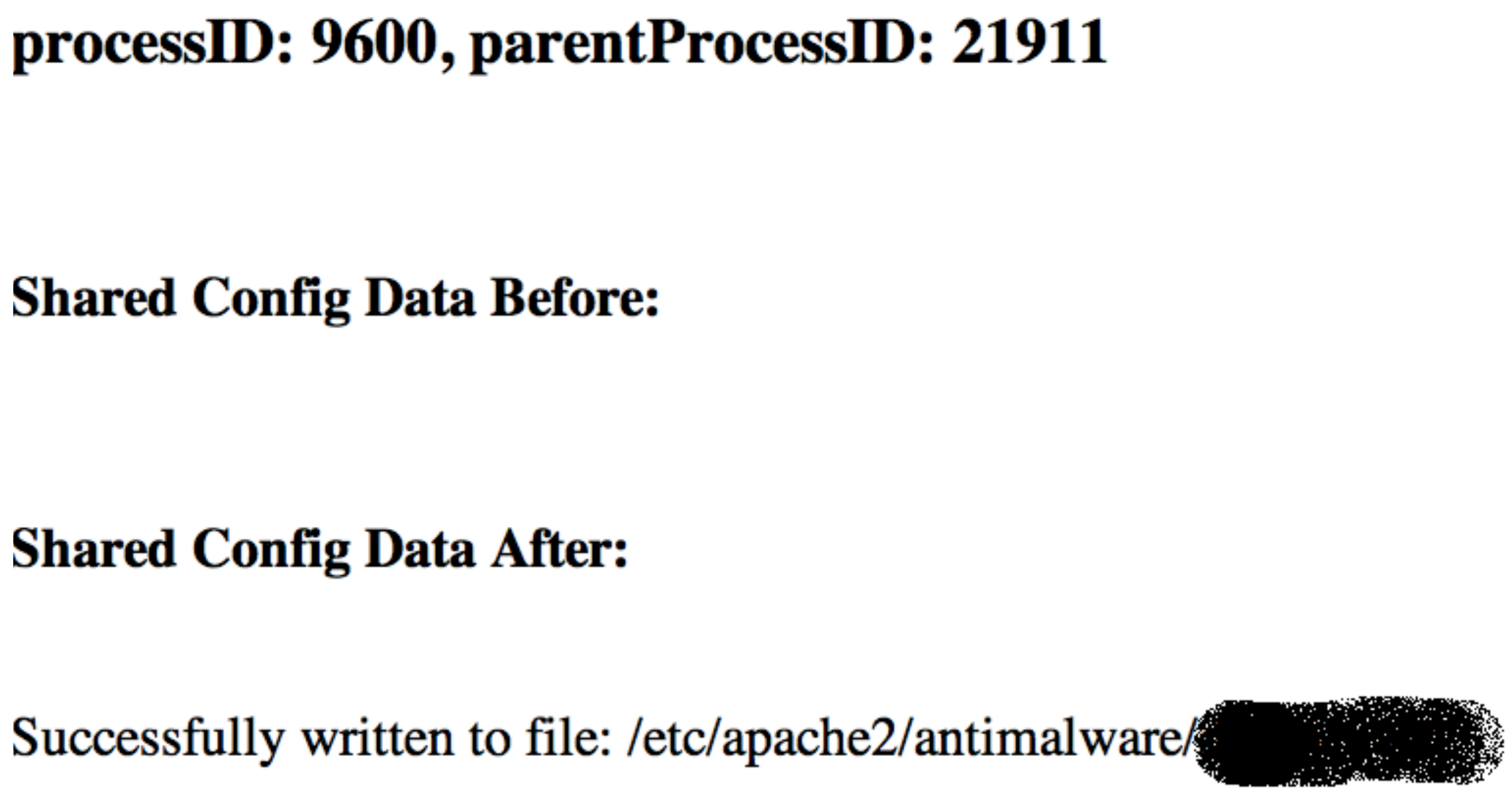
Status

processID: 30051, parentProcessID: 21911

My Config time: Sun Jul 18 06:53:11 2010
Shared Config time: Sun Jul 18 06:53:11 2010
Shared Config Data: initial_data

```
QuarantineBytes 0 0
Total Bytes Parsed: 0
Quarantine Enabled: 0
BlacklistRedirectMessage set: 1
BlacklistRedirectMessage: This server is experiencing technical difficulties. Please come back later.
BlacklistRedirectUrlPrefix: /foo1.html
```

Mod_antimalware Architecture: /configz



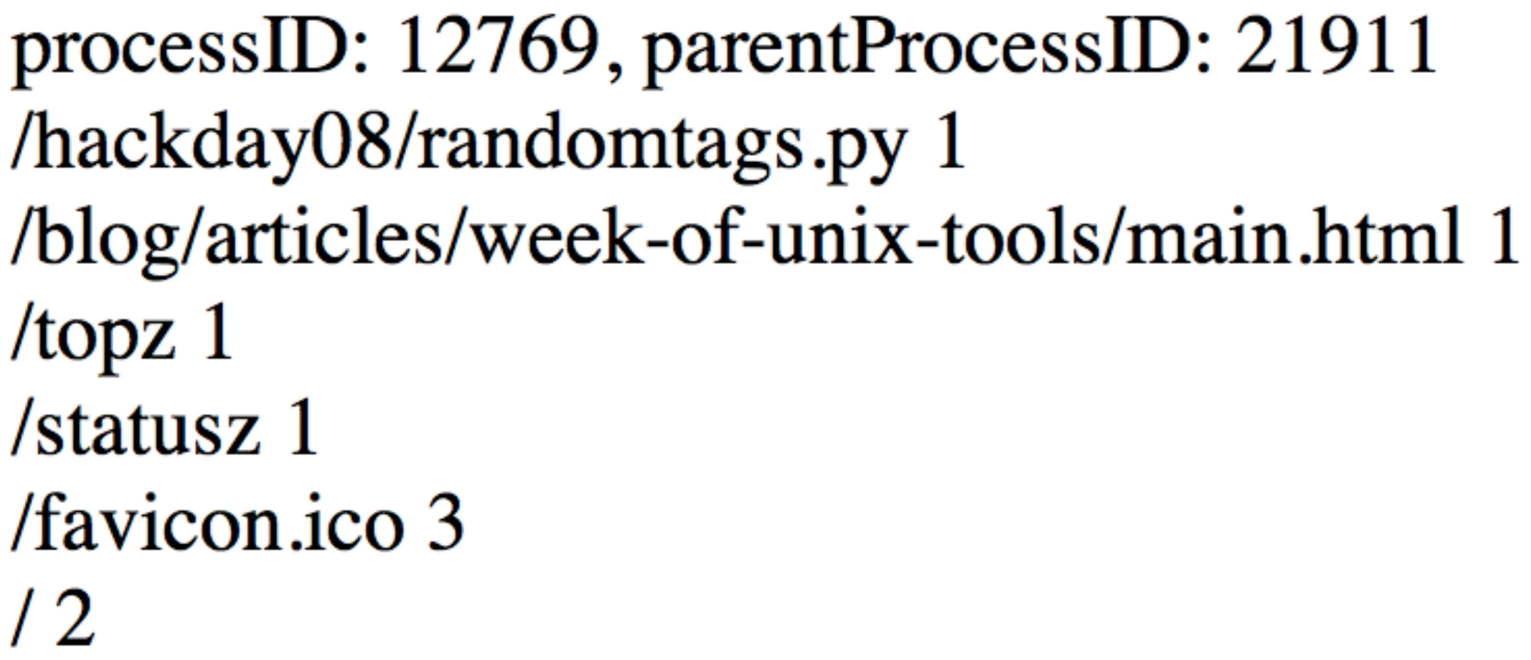
processID: 9600, parentProcessID: 21911

Shared Config Data Before:

Shared Config Data After:

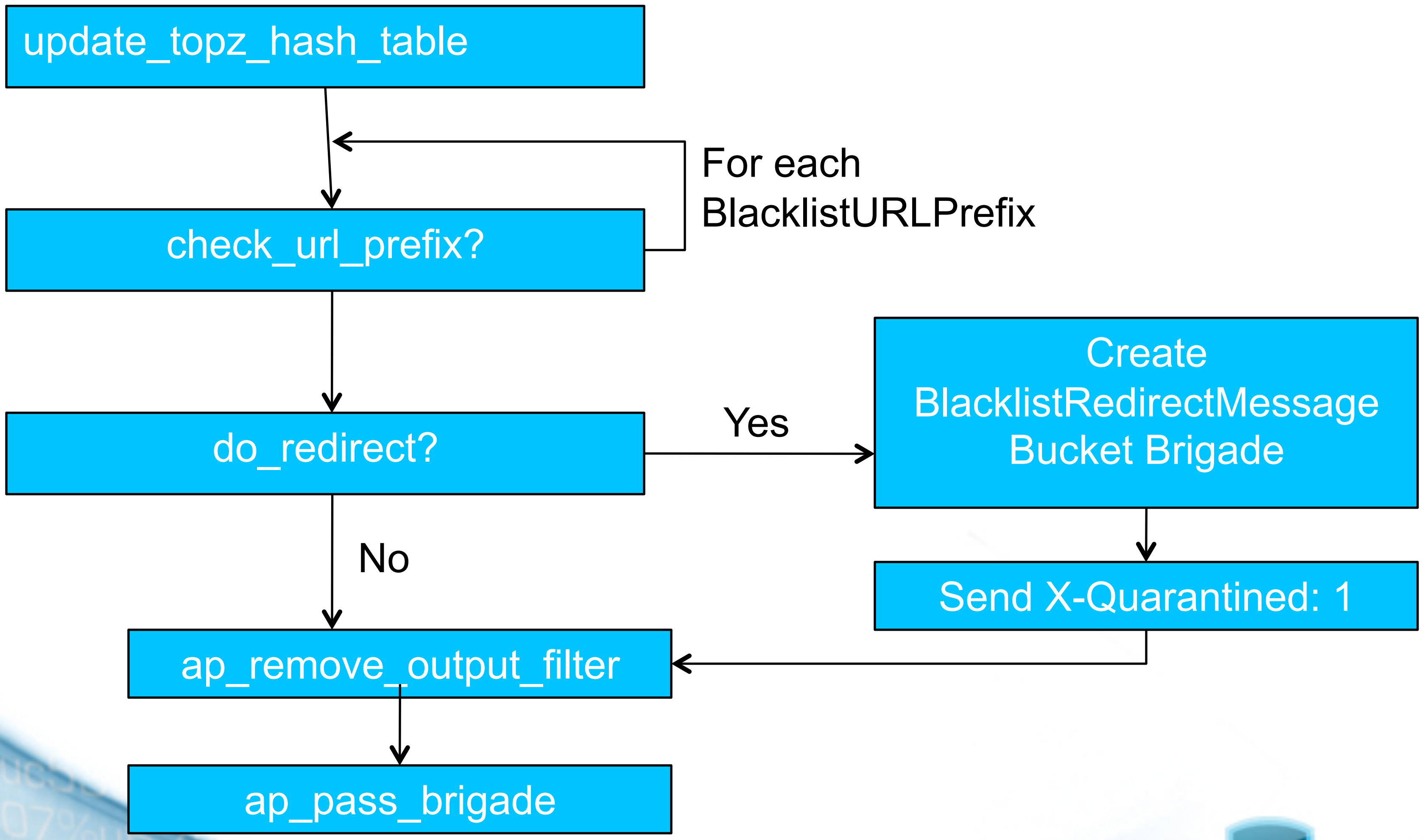
Successfully written to file: /etc/apache2/antimalware/[redacted]

Mod_antimalware Architecture: /topz



```
processID: 12769, parentProcessID: 21911
/hackday08/randomtags.py 1
/blog/articles/week-of-unix-tools/main.html 1
/topz 1
/statusz 1
/favicon.ico 3
/ 2
```

Mod_antimalware_lite Architecture: quarantine_filter()



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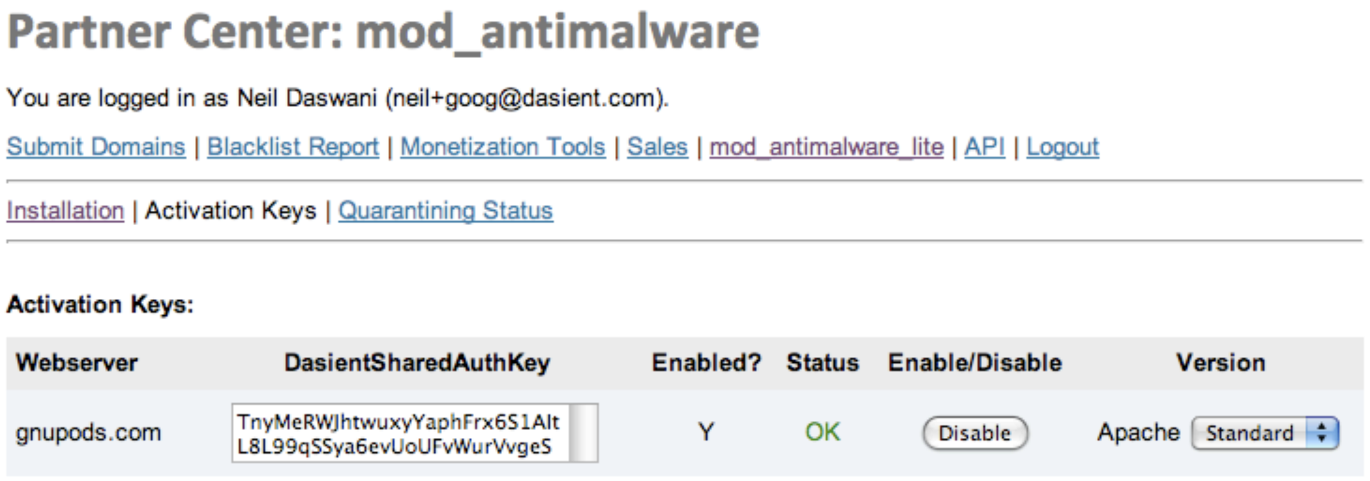
Mod_antimalware Implementation

Authentication



Partner Center: mod_antimalware

You are logged in as Neil Daswani (neil+goog@dasient.com).

Submit Domains | Blacklist Report | Monetization Tools | Sales | mod_antimalware_lite | API | Logout

Installation | Activation Keys | Quarantining Status

Activation Keys:

Webserver	DasientSharedAuthKey	Enabled?	Status	Enable/Disable	Version
gnupods.com	TnyMeRWJhtwuxyYaphFrx6S1Alt L8L99qSSya6evUoUFvWurVvgeS	Y	OK	Disable	Apache Standard

Quarantining Verification

Restart-free Reconfiguration (via shared memory) + Persistence

Future Work

(open-source projects available)

Virtual Host Support

Certificate-based mutual authentication

Automatic deployment of quarantining directives

Where to learn more

- mod_antimalware SourceForge Page:
  http://sourceforge.net/projects/modantimalware/
- Dasient Home Page / Blog / Twitter:
  http://www.dasient.com
  http://blog.dasient.com
  http://twitter.com/dasient

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Where to learn more

- Neil's Home Page: http://www.neildaswani.com

- Stanford Security Certification Program: http://bit.ly/90zR1y

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Where to learn more

Foundations of
Security
What Every Programmer Needs to Know
Neil Daswani, Christoph Kern, and Anita Kesavan
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Foundations of Security:
What Every Programmer To Know
by Neil Daswani, Christoph Kern, and Anita Kesavan (ISBN 1590597842)

Book web site:
http://www.learnsecurity.com/ntk

Free slides at:
http://code.google.com/edu/security

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