The Highly Insidious Extreme Phishing Attacks

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Introduction

• Phishing: uses spoofed websites to steal users’ passwords and online identities.

• Defense:
  – Blacklist-based
  – Heuristics-based
  – Whitelist-based

• Phishing reporting and verification services:
  – APWG & PhishTank

• Phishing attacks have also been quickly evolving to evade the detection and defense.
Introduction – cont.

• First-layer context: a spoofed email or instant message
  – To lure users to the phishing websites

• The success is limited by two constraints
  – If phishing emails or instant messages are suspicious
    • Users would not click on phishing URLs
  – If phishing emails are captured by spam filters
    • Cannot even reach users in the first place
Introduction – cont.

• Second-layer context: look and feel similar to a targeted legitimate website
  – To lure users to submit their login credentials

• The success is limited by two constraints
  – If phishing websites trigger warnings if they are detected by browsers
  – If the look and feel of the undetected phishing websites are suspicious
Our Goal

• We explore the **feasibility of the extreme of phishing attacks!**
  – that have the almost identical look and feel as those of the targeted legitimate websites

• We **evaluate the effectiveness** of such phishing attacks by performing a user study
## Metrics for Look and Feel

- **We focus on the second-layer context**

<table>
<thead>
<tr>
<th>Phishing Type</th>
<th>Appearance</th>
<th>Page Depth</th>
<th>Support to Dynamic User Interaction</th>
<th>Phishing Types</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extreme Phishing</td>
<td>Similar in every way</td>
<td>Unlimited levels of pages with completely modified links</td>
<td>Yes</td>
<td>Traditional &amp; High-quality SSO</td>
</tr>
<tr>
<td>Advanced Phishing</td>
<td>Mostly similar</td>
<td>Limited levels of pages with partially modified links</td>
<td>No</td>
<td>Traditional &amp; Low-quality SSO</td>
</tr>
<tr>
<td>Simple Phishing</td>
<td>Somewhat similar</td>
<td>One page with partially modified links</td>
<td>No</td>
<td>Traditional</td>
</tr>
</tbody>
</table>

- **The appearance**: page layouts, text contents, images, styles
- **The page depth**: the levels of webpages that are organized and linked together
- **The support to dynamic user interaction**: user interactions such as clicking, searching, and form submission as well as the triggered JavaScript executions
- **The phishing types**: traditional phishing and Web Single Sign-On (SSO) phishing
Web Single Sign-On (SSO) ?

• Sign in multiple relying party (RP) websites using one single identity provider (IdP) account.

• Users are relieved from the huge burden of registering many online accounts and remembering many passwords.
A Measurement of Existing Phishing Websites

• In 2015, measured and inspected 471 live phishing websites reported on PhishTank
  – 30% do not contain any link
  – 22% contain invalid links
  – 17.6% contain links to the targeted legitimate websites
  – 26.4% contain links to other websites

• The majority of them, 449 (95%) of 471 – Simple phishing
• Only a handful of them – Advanced Phishing
  – 2 Yahoo, 7 Paypal, and 11 Gmail are mostly similar
  – 2 Paypal contain over two levels of webpages
  – 10 phishing websites support low-quality Web SSO phishing

• None of them – Extreme Phishing
High Level Design of A Toolkit For Extreme Phishing

Visitor

Phishing Websites

Web Server

Webpage Generation
- Temporary Webpage Repository
- Link Substitution
- Web SSO Library

Toolkit

Legitimate Websites

Visitor

1

2

3
Link Substitution

• Our toolkit needs to ensure that all the links on each phishing webpage will be modified to point to the phishing website.
  – To keep holding visitors on a phishing website.
  – To maximize the chances of collecting their login credentials.

• Static Link Substitution:
  – Legitimate domain -> phishing domain & HTTPS -> HTTP & customizable rules for special links (in <head> and <script>)

• Dynamic Link Substitution:
  – Injects JavaScript to intercept the dynamic link generation and modification events & legitimate domain -> phishing domain & HTTPS -> HTTP
Web SSO Login Window Generation

• More profitable and insidious because
  – The value of IdP accounts is highly concentrated
  – The attack surface area is highly enlarged
  – The difficulty of phishing detection is highly increased

• We achieve
  – The automatic and dynamic construction
  – The automatic inclusion of Web SSO phishing login windows
The Single Sign-On login windows on the Sears phishing website (the fake Yahoo, Facebook, and Google login “windows” have the almost identical look and feel as those of legitimate login windows)
User Study

• We provided a computer for all the participants
  – Modified the *hosts* file
  – Installed and configured *five popular browsers*

• This testbed – **Realistic!**
  – Allows participants to use their real login credentials
  – Perform real browsing activities

• Participants - 94 adults
  – 57 younger (18-38 years), 37 older (50-88 years)
  – 62 female, 32 male

• Each participant performed 4 tasks on 4 websites
  – 2 were extreme phishing websites (traditional, SSO)
  – 2 were legitimate websites (traditional, SSO)
  – Each task – browse the corresponding website as he or she usually does, log into it, and sign out

• Data collection through behavioral observation & questionnaire
User Study - Summary

- **87 (92.6%)** were not suspicious about extreme phishing websites
- **91 (96.8%)** submitted their login credentials to extreme phishing websites
- **No significant difference** in lack of susceptibility to the entire phishing testbed between
  - Those who did and did not report noticing something suspicious about the Web browsing tasks
  - Those who with and without reported awareness of phishing
  - Those who with and without a past history of reported phishing susceptibility
- Note that the success rate of existing phishing attacks in terms of the second-layer context is about 10% as reported in previous measurement studies.
Conclusion

• Explored the extreme phishing attacks and investigated the techniques for constructing them
• Designed and implemented a concrete toolkit
  – Traditional phishing and Web SSO phishing
  – Automatically construct unlimited levels of phishing webpages based on user interactions
• Designed and performed a user study with 94 participants
• Demonstrated that extreme phishing attacks are indeed highly effective

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