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The Highly Insidious Extreme Phishing Attacks

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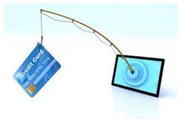
Introduction

- 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.

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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

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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

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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

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Metrics for Look and Feel

- We focus on the second-layer context

	Metrics			
	Appearance	Page Depth	Support to Dynamic User Interaction	Phishing Types
Extreme Phishing	Similar in every way	Unlimited levels of pages with completely modified links	Yes	Traditional & High-quality SSO
Advanced Phishing	Mostly similar	Limited levels of pages with partially modified links	No	Traditional & Low-quality SSO
Simple Phishing	Somewhat similar	One page with partially modified links	No	Traditional

- 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

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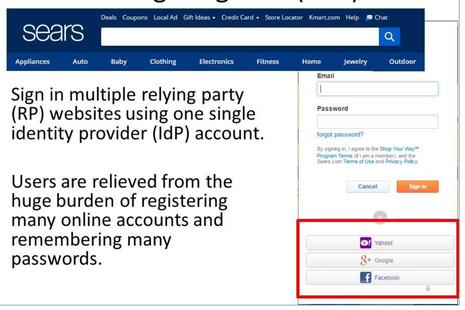
Web Single Sign-On (SSO) ?



- 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.

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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

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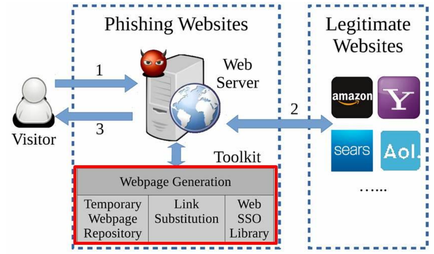
High Level Design of A Toolkit For Extreme Phishing



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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

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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

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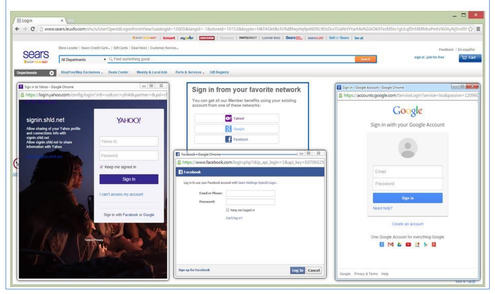
The Single Sign-On login windows on the Sears phishing website (the fake Yahoo, Facebook, and Google login "windows" have the almost identical look and feel as those of legitimate login windows)



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

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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.

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Discussion - Defenses

- Heuristics-based solution
  - That only uses features extracted from visual or non-visual elements on webpages may fail
  - That uses features extracted from URLs may become either inaccurate or incorrect on the detection of Web SSO extreme phishing attacks
    - Host the base webpages for Web SSO phishing attacks on legitimate websites
- Blacklist-based solution
  - Indirectly affected if the construction of their blacklists relies on heuristics-based techniques or anti-phishing communities
- Whitelist-based solution - more robust

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Discussion - Suggestions

- We suggest that researchers should seriously consider extreme phishing in their heuristics-based phishing detection solutions.
- We suggest that Web users should be trained to
  - Be aware of extreme phishing
  - Pay more attention to the domain name of a URL
  - Differentiate the spoofed Web SSO login "windows" from real ones

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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
- Discussed the impacts of extreme phishing on existing phishing defense mechanisms
- Provided suggestions

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