

# Protect the Internet Consumer's Identity against Attacks by Phishers

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## ABSTRACT

Can users believe what their browsers tell them? Even sophisticated web users decide whether or not to trust a server based on browser cues such as location bar information, SSL icons, SSL warnings, certificated information and response time. In their seminal work on Web spoofing, (Felten-1996) showed how, in 1996, a malicious server could forge some of these cues. However, this work used genuine SSL sessions and Web Technology has evolved much since 1996. The web has since become the pre-eminent medium for electronic service delivery to remote users, and the security of many commerce, government and an academic network application critically rests on the assumption that users can authenticate the servers with which they interact. This situation raises the question: is the browser-user communication model *today* secure enough to warrant this assumption?

## Keywords

swindler, phishing, identity theft, consumer's personal identity, keylogging

## 1. INTRODUCTION

Phishing is a criminal mechanism employing both social engineering and technical subterfuge to steal consumer's personal identity data and financial account credentials. [3] The web is the medium for an increasing amount of business and other sensitive transactions, for example for online banking and brokerage. Virtually all browsers and servers deploy the SSL/TLS protocols to address concerns about security. However, the current usage of SSL/TLS by browsers, still allows web spoofing, i.e. misleading users by impersonation or misrepresentation of credentials. Swindler can perform web spoofing by clever attacks, which are likely to mislead even technically savvy and wary users, or by simpler techniques, which would still mislead most laymen and probably even many expert users, when not on their guard. Indeed, there is an alarming increase in the amount of real-life web-spoofing attacks, usually using the simpler techniques. Often, the swindlers lure the user to the spoofed web site by sending her spoofed e-mail messages that link into the spoofed web-sites; this is a phishing attack. In a typical phishing attack, spoofed spam e-mail messages are lure The victim into spoofed web sites, e.g. impersonating as financial institutions.

## 2. EXTENT OF THE PHISHING PROBLEM

Researchers agree that the first phishing attacks were launched in late 2003 [1]. Since then, the phishing problem has grown significantly and, according to security researchers, this type of scam is currently one of most prevalent Internet threats. The Denver-based First Data Group, one of the largest electronic financial transactions with 2000 participants, showing that 43% of USA adults have been subjected to phishing [34]. At the beginning of 2004, the APWG reported that most of the major banks in the

USA, UK and Australia had been misrepresented by phishers. By the end of December 2004, Symantec was seeing an average of 33 million phishing attempts per week, up from an average of 9 million per week in July 2004 [8]. At the end of 2004, phishing attacks had reached 57 million US adults and had compromised at least 122 well know brands [31]. According to the Phishing Activity Trends Reports of the APWG, the number of monthly phishing attacks has grown so much during months that is has reached epidemic proportions. During 2005, victims reported 14987 phishing scheme e-mails to the APWG, an increase of approximately 214% over the monthly number of reports receive.

## 3. CAUSE OF PROBLEM

Brett Myroff, CEO of Sophos distributor Netxactics, states that humans are 'the weak link in the security chain' [7]. Researchers from the HoneyNet Project and Research Alliance, which focuses on collecting data gathered from observing real-world incidents, has concluded that launching phishing attacks on home or small business computers appears to be particularly popular, presumably because 'the systems are often less well managed'. Lack of sound security practices by individuals provides fraudsters with a base from which to launch phishing attacks on unsuspecting consumers [17].

British research conducted for the 2005 Info security Europe event revealed that an alarming nine out of ten individuals leave themselves vulnerable to identity theft. More than 180 of the 200 respondents questioned freely divulged personal information that fraudsters could use to commit identity theft [7].

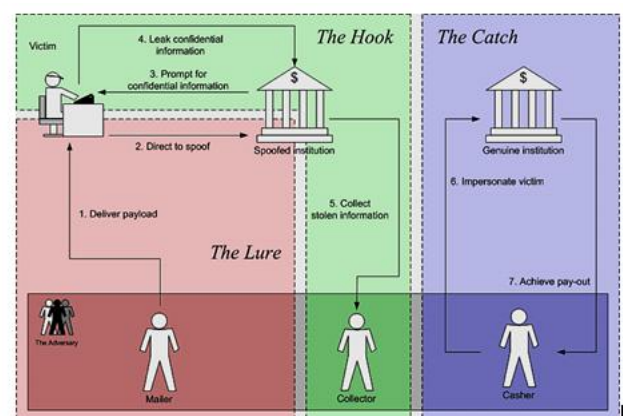


Figure 1 Graphical presentation of typical phishing attack

4. **POSSIBLE SOLUTION:** As phishers rely on their ability to trick unskilled consumers [17], Internet consumers need to address the problem by consciously striving to become more aware of the risks of providing sensitive data online; by adopting improved security practices [7]; and, according to Gartner, by continually updating their knowledge regarding such risks by

benefiting from relevant educational programmes [1] [33]. Internet consumers need to be informed about the threats posed by phishers, to enable them to protect their identities adequately against identity theft. Internet consumers need to know of the possible risk of identity theft; they need to be familiar with the tell-tale signs of a typical phishing attack; and, more importantly, they need to know how to prevent such attacks, as well as how to react appropriately and promptly on discovering that they have already fallen prey to a phishing attack.

## 5. OBJECTIVES & RESEARCH METHODOLOGY

Even though there are various ways in which identity thieves can steal identities offline (such as by stealing records from businesses or institutions; by bribing employees; by stealing mail, including bank and credit card statements; or by obtaining personal details for fraudulent ends from carelessly discarded credit card or automatic teller machine transaction records), this research only investigated one method of online identity theft, namely phishing. In this article, the author discusses the *modus operandi* of phishers, as well as the possible results of successful phishing attacks. After a literature review of the relevant available sources, the basic components of a typical phishing scheme, including the phishing message itself, are analyzed. Based on the investigation performed, the article provides guidelines for actions that Internet consumers can take to prevent, detect and recover from phishing attacks. By applying the precautionary and remedial actions proposed in this article, an Internet consumer should be able to prevent falling victim to a successful phishing attack and should also be able to counteract the negative consequences of a phishing attack to which he or she has fallen prey.

## 6. PHISHING SCHEME COMPONENTS

A **phishing attack** consists of three distinct parts: the e-mail message; a fraudulent web site; and a hyperlink that leads to the fraudulent web site, details of which are embedded in the e-mail message concerned [17][26].

The **e-mail message**, appearing to come from a legitimate source, is carefully designed to trick the recipient into providing sensitive personal information, which the phisher uses in a fraudulent manner. The message usually contains a section (the 'bait') that requests the user's assistance in solving a problem.

The **fraudulent Web site** that the phishers set up mimics the graphics and formatting of a legitimate Web site as closely as possible, in order to mislead the victim deliberately. Well-known online brands are often targeted in this way. The APWG reported that 107 brands were hijacked by phishing schemes in May 2005 – a 135% increase from April 2005 [2].

On the Web site the user is prompted to provide confidential personal information that the phisher harvests for his or her nefarious ends. The fraudulent Web site's name is hidden in an **embedded hyperlink** in an HTML-formatted e-mail, in order to disguise the address of the actual Web site the user will be taken to when clicking on the hyperlink. This article does not include a technical description of what happens during a phishing attack. The reader can visit <http://www.honeynet.org/papers/phishing> for a more technical description of the actual techniques and tools used by phishers.

## 7. SUCCESSFUL COMMUNICATION OF THE PHISHING MESSAGE

Successful communication of the phishing message relies on three main aspects: the sender, the recipient and the content of the phishing e-mail.

**7.1 Sender:** Phishers typically pose as figures of authority such as banks, credit card companies and other institutions that are in authorized possession of sensitive personal information relating to their clients. The fraudsters send out e-mail messages to potential victims, falsely claiming to be from the legitimate organizations concerned. The online thieves rely heavily on the victims' innate sense of truthfulness when responding to automated systems or to (apparent) authority figures [17]. The April 2005 Phishing Activity Trends Report of the APWG indicates that 84% of the 11 new brands hijacked in April 2005 originated in the financial services industry [2].

### 7.2 Recipient

To reach the maximum number of potential victims while subjecting themselves to minimal risk, phishers found 'an ideal partner in crime in the form of spam e-mail' [17]. Spam consists of unsolicited commercial e-mail, usually sent from hacked machines [4]. Patrick Evans reports that up to 73% of the mail traffic of a number of South African corporate environments monitored is spam-related and, thus, susceptible to phishing attacks [8].

Legitimate addresses required to create spam can be purchased by thieves on the 'cyber black market', or parsed together using programs that randomly combine last names and first initials with common domain names [5]. The senders of bulk phishing messages know that the vast majority of the people to whom they send such messages will simply disregard the messages, as they ordinarily have no dealings with the organization named in the e-mail. However, they are also aware of the fact that a small percentage of the recipients of the mail messages might be account-holders of the targeted organization and respond to the e-mail as though it were authentic, thus making it worthwhile for the attackers to continue their practice [32].

### 7.3 content of the phishing e-mail message

Both in terms of the 'look' of the message and the code used, phishers are able to mimic authentic messages emanating from the organizations concerned more and more closely [5]. The e-mails sent out by phishers, purporting to be from the organizations themselves, may even feature corporate logos and formats similar to those used by the legitimate organizations.

The e-mail messages usually lure recipients to malicious Web sites, where the victims are duped into disclosing personal details, by means of apparently innocent requests, such as requests for the assistance of the client in solving a 'problem' with his or her account, managing or updating customer information, or requests for urgent action by the user, often, ironically, 'to protect the user's confidential data from malicious activities' [17]. The e-mail recipient may be warned that if he or she fails to respond promptly, a penalty, such as the closure of his or her account, will be imposed. Examples of phishing attacks that have been reported to the APWG can be found at [http://www.antiphishing.org/phishing\\_archive.html](http://www.antiphishing.org/phishing_archive.html).

## 8. RESULTS OF PHISHING AS A METHOD OF IDENTITY THEFT

Research by Gartner shows that phishing victims are likely to suffer identity theft fraud [21]. Identities stolen online can result in the loss of funds and new account fraud (all the figures reported in this section relate to the period 1 May 2003 to 30 April 2004) [22]:

- Illegal purchases made with the stolen account information are the most common type of fraud committed with stolen identities. Such purchases have resulted in more than \$4.5 billion worth of direct losses among approximately 5.7 million online US adults (4% of the online US population).

- Unauthorized transfers, withdrawals and cash advances from accounts of which information was obtained have resulted in nearly 2 million online consumers suffering annual losses amounting to nearly \$2, 4 billion in unauthorized transfers from their accounts. Illegal credit card cash advances have resulted in \$1 billion losses and have affected more than 500000 online customers.
- Identity thieves can open new accounts or obtain credit in the victim's name to make unauthorized purchases of which the victim is unaware. It is estimated that this type of fraud affected 1, 2 million online US adults, resulting in damages amounting to \$2, 3 billion for online US adults. To prolong the period before the fraud is discovered, the thieves often change the billing addresses on the accounts targeted.

Other consequences of successful phishing include the following:

- Victims may be refused loans, education, housing and cars, due to bad credit reports. According to the Federal Trade Commission (FT), victims of identity theft could spend several months, or even years, and vast amounts of money in recovering their good names and credit records [12], after they were damaged by identity thieves.
  - Victims usually experience a number of negative emotions, ranging from humiliation to anger and frustration [12].
  - Phishing can cause consumers to lose confidence in the e-commerce industry [21]. According to a White Paper drafted by ActivCard, phishing attacks the basic element of trust essential for ongoing e-commerce [1]. Brad Nightengale, the vice-president of Visa, states that consumers perceive the online environment as 'exceedingly risky' and that this perception 'could curb online spending' [29].
1. These concerns are supported by a variety of studies. According to Cyota, a fraud prevention service provider, more than 50% of Internet consumers are afraid to conduct online commerce, due to phishing concerns. A Symantec study shows that nearly one-third of the respondents refrain from online banking, due to fears of phishing. Seventy per cent of the Cyota survey participants said that they were less likely to respond to an e-mail purporting to come from a bank, because of fears relating to phishing [29].

## 9. COMBATING PHISHING

Based on the information gathered in this research, the aspects and precautionary measures below should be borne in mind by Internet consumers while interacting on the Internet. By doing so, a consumer will reduce his or her risk of falling victim to a successful phishing attack.

### 9.1 Aspects and precautionary measures aimed at addressing phishing

Be cautious with e-mails and confidential information.

- E-mail is a relatively insecure means of transmitting financial and personal information. Legitimate companies usually refrain from asking clients to supply sensitive personal details via e-mail.
- Personal e-mails from legitimate companies should be addressed to the consumer directly. A message addressed to 'Dear valued customer' indicates that the message was sent out in bulk, thus rendering it more susceptible to phishing. Consumers should never provide personal information to such requests.

- If the consumer is suspicious about an e-mail message received, he or she should phone the institution that supposedly sent the message, in order to confirm and verify the origin of the message. The official call centre number of the institution concerned should be contacted and not the one provided in the e-mail message concerned.
- The consumer must check the messages received for spelling mistakes and bad grammar. Grammatically incorrect or misspelt messages may indicate irregularities. Official communications are usually checked for language proficiency before being sent out.
- The consumer must check that e-mail messages requesting personal details are signed by an official of the company concerned.

Examine the URL (Uniform Resource Locator) displayed in the address or status bar at the bottom of the browser frame. The link to a Web site to which an e-mail refers recipients can be disguised in various ways. Standard HTML code can be used to provide misleading information [32]. The APWG reported that 46% of the May 2005 phishing attacks contained some form of the target name in the URL [2].

- Only a certain number of characters of the URL can be displayed. The longer the URL, the easier it is for the identity thieves to conceal the true destination the Internet consumer will be taken to when activating the link. Phishers can place the 'active' part of the URL at the end of the string, obscuring it from view [32].

Note that most browsers ignore characters preceding the @ symbol in a URL. For example,

<http://www.legitimatecompany.com@phishingscam.com> will actually take the user to Phishingscam.com's site, and not to the Web page of Legitimate Company.

The true URL might be disguised by the substitution of similar-looking characters in the URL. At first glance, the URL might appear to be the name of the organization the Internet consumer is familiar with. However, the name might have been slightly altered by means of the intentional addition, omission or transposition of letters, or by means of the addition of certain hyphens or dots.

One of the first phishing incidents reported disguised Paypal.com as paypal.com [4]. Similarly, the Web site address www.microsoft.com could appear as [www.micosoft.com](http://www.micosoft.com), [www.microsift.com](http://www.microsift.com) or [www.verify-microsoft.com](http://www.verify-microsoft.com) [25]. The user should not cut and paste the link provided in an e-mail message. He or she should retype the URL directly into the browser rather than click on hyperlinks contained in e-mails. Typing in the URL will take the user directly to the relevant Web site. (Alternatively, the user can add the institution's address to his or her list of favourite Web sites, and use this link whenever he or she wants to log onto the relevant Web site.)

Look for indications that the browser and Web site are secure and legitimate.

Ensure that the Web site address is prefixed with 'https' (the 's' is for secure) and not just 'http'. A picture of a padlock (locked symbol) appears on the bottom right of the browser page or status bar in Internet Explorer, indicating a secure Web site. (If there is no status bar at the bottom of the browser window, click on 'View' at the top of the browser and then select 'Status bar' to activate it.) The closed lock must be present on all pages requesting personal information. Unfortunately, no indicator is totally fool proof, as phishers can even forge security icons. The consumer must verify

that he or she is visiting a secure Web site by checking the security certificate of the site concerned. He or she should double-click on the lock icon to display the security certificate. The name following 'Issued to' should match the name of the legitimate site the consumer intended to visit. The consumer should look for the Web site's privacy policy, which describes how the personal information a site collects will be used and protected. If the privacy policy is not displayed or the user is unable to understand it, he or she should consider doing business elsewhere. Consumers should treat supposed 'bargains' (which could be examples of 'Google phishing', as described later in this article) advertised on Web sites with suspicion and only buy from trusted sites, as described above. He or she should bear in mind that, if an offer appears too good to be true, it most probably is.

Consumers should regularly check the activity on their accounts and review credit card and bank statements for unauthorized charges as soon as they are received. If a statement is more than a couple of days late, the consumer should call the bank to confirm the billing address and account balance, as identity thieves often change billing addresses to delay detection of any fraudulent transactions.

## 9.2 Other general security measures

The following general security measures might also assist in providing a safe environment and in minimizing the risk of a successful phishing attack.

- Be suspicious of e-mails arriving from unknown sources.
  - Delete all suspicious e-mails immediately.
  - Use up-to-date spam filter and anti-virus software, in order to reduce the number of fraudulent and malicious e-mails to which you might otherwise be exposed.
  - Install firewalls to block uninvited access to your computer.
  - Install the patches that software providers distribute to close holes hackers or phishers might otherwise exploit.
  - Apply sound password control on all accounts and computers.
  - Delete all personal information on computers that are disposed of.
  - Activate and use the SMS security feature and the random verification number as a prerequisite for beneficiary creation when using Internet banking. The consumer will then be notified via SMS of any activity on his or her bank account.
  - Stay informed about the latest news on fraudulent Internet activity.
2. Immediately report any suspicious activity or e-mail received directly to the faked or 'spoofed' organization (by, for example, calling the customer services toll-free number, and not the number provided in the e-mail message) and to the relevant authorities and the APWG (<http://www.antiphishing.org>).

## 10. WHAT TO DO IF A PERSON FINDS THAT HE OR SHE HAS PROVIDED PERSONAL INFORMATION TO A PHISHER

- If a consumer finds that he or she has provided personal information to a phisher, the following guidelines will minimize potential loss.
- Change the passwords on all accounts as soon as possible.

- Review credit card and bank statements closely in order to detect possible unauthorized activity.
- Immediately, in writing, close the accounts that are known or suspected to have been tampered with.
- Report the incident to the credit card company concerned; the company that has been fraudulently misrepresented; the South African Fraud Prevention Service and the APWG.
- Request that the fraud departments of the local credit bureaus place a fraud alert on the credit file or report. Check and monitor one's own credit report.
- File a report of the incident at the local police station. Secure a copy of the report, or at least the case number concerned, to provide proof of the crime to creditors who may need it.
- Invest in an anti-spam filter and in anti-virus software to filter the messages received in future.

## 11. AFTER A PHISHING ATTACK IS REPORTED

The good news is that the reported phishing incidents are investigated by the relevant authorities, who question the alleged phishers. The phishing Web sites that are discovered are then shut down and the perpetrators arrested.

According to Hemmanth Singh, director of technology engineering at the Standard Bank, the Internet service providers co-operate in taking sites offline if evidence of illegal activities are provided [37]. The Phishing Activity Trends Report of the APWG states that the average time online for a phishing site during May 2005 was 5.8 days; the longest time was 30 days [2], before being shut down.

## 12. PHISHING WITHOUT A LURE

The bad news is that due to ongoing innovations and advancements in the 'art of phishing', new phishing techniques are already, no doubt, under development [17]. Although this research is an attempt to cover the field as it currently stands, it might, therefore, not cover all possible phishing methods and techniques.

According to the APWG, phishers are learning how to void the signs of conventional phishing techniques [2].

These new phishing 'mutations' include 'pharming', 'spear fishing' (keylogging), 'Google phishing' and 'Wi-phishing' [20][29].

**Pharming (or DNS poisoning)** involves redirecting unsuspecting Internet users to counterfeit (phish or password-harvesting) sites that closely resemble the legitimate site, when a legitimate domain's name is entered. Pharmers inject malicious code onto a PC, or even onto DNS servers on the Internet. When logging on to the counterfeit site, the personal information used for logging on is harvested and transmitted to the pharmers concerned [2][14][18][29].

In **spear fishing (or keylogging)**, fraudsters load programs, known as keystroke-loggers, onto the end user's directory. Upon rebooting the computer, the application modifies the system registry files and tracks the keystrokes of people using infected machines. The keystroke-loggers activate when certain keywords are typed into browsers, or when specific predetermined sites are accessed ([10][15][28][29].

For example, the keystroke-loggers can capture the login names and passwords for online bank accounts when customers do e-banking and send this personal information to the attackers. Keystroke-loggers can become hidden and infect computers in various ways, including the opening of phony e-mail attachments,

on downloading programs online (usually 'free' software), and through fraudulent Web sites, accessed when users mistype the names of common Web sites [10] [15] [28] [29]. The March 2005 Phishing Activity Trends Report of the APWG reported a dramatic increase in the amount of phishing-based malicious code designed for logging keystrokes. From February to March 2005, researchers reported discovering eight to ten new keylogging systems and more than 100 crime warehousing Web sites per week, in comparison to the discovery of an average of one to two new phishing key logger variants and ten to 15 new malicious Web sites hosting this code per week from November 2004 through to December 2004 [2].

In **Google phishing**, phishers use search engines to drive traffic to illegitimate sites, on which they claim to be selling a product or service, usually at unbelievably low prices. The phishers set up fraudulent Web sites and, as they have no intention of making any legitimate sales, they can claim to be selling virtually anything at any price that they think is likely to attract victims to their Web site. With this form of attack, phishers do not initiate contact with their potential victims, but the Internet consumers themselves search out the phishing site by means of entering certain key terms in a search engine, such as when, for example, searching for the cheapest online airline tickets. Internet consumers, having appeared to have 'found' the site by themselves, gain a false impression of it being a secure and legitimate site [29].

When buying from the site, users have to complete forms requiring their personal details, including their credit card information and expiry dates, online. On submission of the form, an error message is displayed, informing the consumer that a problem had occurred and that the transaction was not completed successfully. Meanwhile, the phisher will already have gained access to the information concerned, which maybe used for future fraudulent purposes [9][29].

**Wi-phishing** entails the phishing of personal information from consumers who make use of wireless technology and Bluetooth facilities. The cyber crooks set up Wi-Fi networks in public places, which users of wireless broadband connections tend to frequent. While using what they might assume are legitimate networks at designated hotspots, the users can have their personal information (in the form of keystrokes and passwords) tapped into by wi-phishers, who harvest personal information through their own networks [10] [29].

### 13. CONCLUSION

For most purposes, an online consumer is only a number transacting over the Internet. The Internet consumer should actively protect the confidentiality of his or her online identity in order to prevent identity theft. Online consumers need to learn how to prevent and cope with fraudulent Internet activity aimed at extracting personal details for the financial benefit of phishers. A consumer should be able to recognize the signs of a possible phishing attack and know how to react to a phishing e-mail message that he or she receives. By considering the various aspects covered, and by applying the precautionary measures suggested in this article, the Internet consumer will significantly reduce his or her chances of falling prey to phishing attacks. The actions recommended in this article to Internet consumers who have responded to phishing messages, should also assist in minimizing the negative effects that might otherwise be suffered as a result of phishing. Al DiGuido, CEO of Bigfoot Interactive, asserts, in an article named 'Study: Fraud is Consumers' No. 1 Concern', '[p]hishing will only be diminished when people are completely educated' [27].

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