Phishing Attack Prevention: How to Identify and Detect Phishing Attacks

Proposal #4 – Revision

by

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# Abstract

Internet has become the means to live a life which has been deeply integrated and embedded in our day-to-day life. It can be anything ranging from an online app which you visit or any social networking sites, financial sites, booking a Doctor’s appointment, ordering food, navigating to a destination, advertisements, movies and many more which makes humans life easier by accessing them in a short amount of time and mostly on the fly. Because of extensive use of Internet in daily life the technology has started to become vulnerable and therefore intense threats have been discovered following the technology. It has given birth to a new way for hackers to lure a victim into giving away their personal identity or to steal information digitally. Phishing is a form of cybercrime where a hacker/attacker for that matter pretends to be the real person or an entity by elevating them as the official owner through any communication medium, the famous of all and most popular is through e-mails, where an attacker spoofs an email or through instant messaging. The attack mainly focusses on people with no knowledge on Internet Security or to those who don’t take care heir security or privacy seriously. It can be a Bank Account or any social engineering account such as Facebook, Yahoo, Instagram, Gmail or any Online account. This paper will provide information about types of phishing attacks and steps that can be taken to shield user’s confidential information

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# Introduction

Internet has changed the way we live, it has dominated many fields by increasing the comfort level for users/humans, however on contrary it has also brought few disadvantages with it, one of the most important things that comes to everybody’s mind is security, when surfing on the Internet. Everyone online takes utmost caution to protect their business by patching their server and by fixing the vulnerabilities to safeguard their business through Internet. Phishing is one of the online forms of identity theft that can be used to steal private information of an individual. Phishing scams has been receiving the utmost attention as this clearly have been on the rise, there is no single remedy that can protect a user from phishing scams (A. Alswailem, 2019)

The word ‘Phishing’ was introduced in 90s, in the earlier day’s hackers used to use ‘ph’ in replacement to letter ‘f’ and the hackers in that generation were also known as *Phreaks*. Phreaking is the term used for study, exploring, experimenting of telecom system. Since phreaks and hackers were closely linked, ‘ph’ was linked to phishing instead of fishing and since this attack lures a victim to give away their personal information just as the analogy with ‘angling’ where the attacker sets email lures by positioning the hooks to ‘fish’ for sensitive information which can include their identity information or banking passwords or any type of financial data from the ‘sea’ of users on the Internet (Gürel, Detection of phishing attacks, 2018)

One of the main goals of phishing is to conduct a fraudulent transaction by using a fake email by luring the user to click on the URL and redirect them to an illegitimate website which looks exactly the same as their banking website and steal their username and password that way or to entice a user to give away their social security number or any private information such as name, address , phone of an user which can be used to either apply for a loan or for a credit-card on behalf of the user

There are various types of phishing scams and these tend to continue as the techniques has been successful enough for cyber criminals in making hefty profits. Phishing has been around since the origination of Internet and they are not going away any time soon. There is always a chance for you to fall for these traps and therefore it becomes imperative to adapt basic guidelines in keeping yourself safe. Always keep up with the information on Phishing, think twice before clicking on any URLs, Install an Anti-phishing toolbar, Verify the certificate and the site security of the website, check your Online A/c’s and passwords regularly, rotate the passwords frequently, enable Multi Factor Authentication, never give away your private/personal information

While many methods have been developed to tackle phishing attacks none of them are efficient enough to mitigate new phishing attacks that are constantly being developed and cannot filter all the malicious email content. This paper describes about the methodology and approach along the various phases and the differences between a normal approach to a website versus a phishing attack redirect. While Phishing websites are designed to looks like the original page there is always a slight difference which one needs to understand. The Sony hack which was pulled in 2015 is a great example of a successful phishing campaign and illustrates the damage that can do to an organization, the damage done to Sony was at a bigger scale in millions of USD

Therefore, the key is to take a proactive approach by educating your users which is the most important part in anti-phishing strategy. To Design an effective anti-phishing strategy includes various factors, and is intended to improve person’s knowledge on phishing, this can be in the form of videos or simlets or printed materials. Phish tank is a website which has database of all the phishing websites, it updates its records by monitoring the entire Internet and I mainly created for user’s awareness. By submitting the URL, you can verify whether the url is a potential phishing site. Deep packet inspection is one of the Network Techniques which is used to dig into a packet level, many countries use this mechanism to surveillance on the Internet and to monitor any malicious activity over the Internet (M. Adil, 2020)

# Research Questions

As lot of the users become Internet savvy the Internet has become an integral part of our life. On the contrary it has also brought lot of disadvantages and threat opportunities for Users with ill intent to perform malicious activities like Phishing. While many methods have been developed to identify and detect Phishing, one of the most successful among them is through Machine Learning. ML provides simple and effective methods for analyzing the data and has brought some promising in eliminating some real time problems. ML can be a powerful tool in the current situation where it can quickly detect any fraudulent transaction and help develop learning-based solution (Vahid Shahivari, 2020). The risk of disclosing private sensitive identifiable information is very high and therefore become applicable that a thorough research is conducted to identify and discover the outcomes associated with phishing attacks

Phishing has been defined as social engineering which tends to steal information through guise of a trusted source (Jakobsson, 2007) With over a billions of Users currently using Internet all over the world, there are not a less number of potential victims to achieve identifying information from, Social Engineering is further defined as an ‘old way of conning’ with efforts put in place to gather personal identifiable details to launch a successful attack (Easttorn, 2011) The following research uses a real time approach to gather data which leads to phishing scams. Knowledge/Educating users is one of the important factors to prevent a user from falling to phishing or social engineering attacks. There are lot of training videos out there which provides a user with ammo and provides them with an opportunity to explore and understand the response to a phishing attack

Providing with the right tools and the necessary knowledge to a User to not fall for scams becomes very important. Phishing is a cybercrime however crimes related to it can be difficult to investigate to get to a verdict due to number of reasons such as Delay in crime reporting, temporary phishing sites which are brought up and down on a regular basis in just a short amount of time deleting any trace related to the crime etc. Most of the Users often do not report these scams if their financial loss is low or negligible (White, 2008) While Phishing scam websites are taken down in a very swift manner research (Moore, 2007) show it may have number of potential victims before taking down the website (Chhikara, 2013) The research will provide valuable insights to inner and knowledgeable response that appears when a User experiences a Phishing attack. There might be many reasons as to how and why a user chooses to fall for a phishing scam, even after knowing the consequences, knowing this will provide insight related to the response to phishing attacks and will help develop training sessions to further assist in preventing an individual from falling these attacks

# Significance and Justification

## Background

In the past few years, the amount of unique phishing emails has exponentially increased, Phishers can steal sensitive data from users to access an individual’s financial information and initiate a illegitimate wire transfer or withdraw money without the users consent, this has put the organization and the individuals both at risk. Due to these consequences, most of the companies have now started to educate their employees about different types of phishing through security awareness and various training program and have implemented a way to inform their IT department of any phishing email s they receive. The training provided by the organization can be limited for a short time and therefore the long-term benefit of Phishing attack prevention remains a question. Fascinated by this challenge, this study/research targets to determine the stretch one can experience by using various techniques to keep the user engaged in preventing Phishing attacks (APWG, 2003)

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## Justification

The main objective of this paper is to propose a study/research to assess the concept model of how to encourage individuals to participate which will help a user in long run to identify and prevent phishing attacks at the same time by improving phishing reporting. The research will take a mixed approach and will include various measures or methodologies developed to tackle Phishing scams. Furthermore, a research is going to be performed on various phishing software platforms and browser addons to gauge the tools capabilities and use them in the real-world shielding user’s sensitive data. The outcome of this research will have potential to be published in a security research journal and can potentially be a funding initiative by NIST as this is an important area of research for Cyber security. This research will help explore the emotions of users falling for these phishing scams as well as provide training to make them realize the negative side of providing their private information and the consequences related to it

# Literature Review

This research is fairly new and is subject to change as the new threats continue to appear. The research focusses on different types of Phishing scams that have currently gained traction, understand how a user falls for these scams and how to identify and respond to the scams. By providing a theory related to phishing scams with existing research will not help in expanding the research in general for Phishing but also provides an opportunity to explore more about the phishing communications and what can be done to bring awareness to the Internet users

Over the years, given the fast adoption of latest technological advancements, security exploitation/attacks have significantly on a rise topping the human vulnerability. Phishing has become one of the threats to cyber world creating a massive damage of worth billion dollars every year. Phishing can be performed in different methods involving web, email, messages etc. Over time there has many articles describing the techniques and new attacks based on phishing however, they have failed to outline all the risk factors involved and provide and efficient/effective solution to mitigate this form of a threat. In this section we will be comparing different data from various sources to perform a literature review. Emails has been always one of the main online application which is used extensively by lots of users, business, Govt and different organization for communicating with one another and sharing data and therefore phishing emails has always shown us a serious threat to digital commerce as they are used to scam both individual and financial institutions (A. N. Shaikh, 2016)

# Problems and Challenges

Hacker/phishers have become advanced and more talented/skilled at recreating/forging sites to appear identical including recreating logos and graphical presentation. No doubt Phishing is evolving to tackle the defenses and bypass the detection. In these circumstances I think a sequential approach is needed which will help mitigate these kind of attacks

1. Prevent Phishing
2. Detect Phishing
3. Provide Stake holder training

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Figure 1 Step by Step process

### Prevent Phishing

Phishing can be prevented by taking extra precautions and blocking it before it reaches the users, this includes blocking or blacklisting the phishing site by filtering emails. The first procedure is to identify the URL either manually or by ML, although this can help catch few sites, it cannot catch them all

### Detect Phishing

This method is deemed to be one of the effective methods as this can identify the link to phishing sites through the spam filters which are majorly used by the email servers. Phishing filters are constructed by Machine Learning techniques. Most of the browsers already have an extension installed on their browser which has a passive or an active indicator warning the users and alerting them at the same time

### Providing Stake holder training

By providing training to all the users can help avoiding the users clicking random sites and falling into Phishing scams. Most of the organizations create internal training program to combat against advanced phishing attacks which is often referred as anti-phishing techniques/methods. One of the famous anti-phishing games is Anti-Phishing Phil which is a micro game that helps a user identify suspicious URLs and spread awareness also provide a detail view of the consequences (Jampen, 2020)

# Impact of Anti-Phishing Training

### Introduction

There are many publications that provide insight on how a user will become a victim to phishing scams even after providing them with various anti-phishing techniques or through an integrated workflow training. The training is basically where an automated system sends a set of phishing emails to users, the users have to identify and report them to respective team during a typical workday. These types of training are often referred as embedded training, they are designed to be more realistic and take a practical approach. The accuracy of Anti-phishing techniques is not always effective against all type of threats. While the studies show the accuracy of Anti Phishing is a critical factor in reduction of successful works of phishing attacks there are other things like enhancing user’s knowledge, improving tool etc. which has a strong implication for an individual as well as to the organization

### Recent Survey

In (Neupane A, 2015) one of the studies conducted in identifying a real website vs a phishing website at neuro physiological level governing the human processing shows how we take a 3-dimensional approval to detect phishing and how a user thinks about these tasks. As per the multi modal neuro physiological measures, users do not like to spend additional time analyzing the important indicators and therefore fail identifying these attacks. They may still have or think about the task however can subconsciously proceed to phishing sites when compared to a real site

One of the most recent work by one of the authors in a retrospective carried out in 6 health care institutions (Kumaraguru P, 2007) show there were approx. about 95 campaigns that were run from 2001 to 2018 with a whopping 3 million phishing emails by sending them to users of their respective organization. (Carella A, 2017) The universal clicking of email were relatively high, however varied per institution, on an average there were about 14% of those simulated emails which were clicked by their employees during a workday. By Conducing numerous phishing campaigns have reduced the odds of potential clicking on possible phishing emails, the odds of phishing emails went down by 0.5 lower for about every 4 to 7 campaigns. They have also found difference in click rates among the institutions (J, 2017)

There are various ways how phishing scams can be designed, they are most commonly designed in one of two ways, the first one is by targeting or triggering an individual greed and the other type is to manipulate a user by sending threatening communications. Sentences/phrases such as “act now, its urgent” failure to comply will result in permanent suspension etc are used to make it look like you need to take an immediate action or face consequences. One of the examples is sending a communication related to your email storage, which typically says, you have exceeded your 50Gb of storage and threatens the recipient that they will not be able to send/receive emails or that their Account will be revoked. Users don’t think twice about providing log-in information.

### Threat

A threat is inclined to cause harm or loss to another person, in this scenario phishing threat is to fraudulently steal personal identifiable information from an individual user or an organization or to inject a malicious software by acting as a trusted entity. Threats are commonly delivered by visiting unknown websites or delivered via emails which can include any type of advertisements on genuine sites that have been potentially exploited. One of the most common form of phishing related deception is Stealing Identity (Bakhshi, 2008) where the attacker targets a victim by gathering private information to socially engineer or to tailor fit the attack

### Summary

The use of various training programs helps enhancing both user and enterprise awareness towards phishing scams providing new insights to prevent phishing and eventually stopping users to give away their personal identifiable information or sensitive information such as usernames password or their financial details. Phishers are adopting new tricks to lure and confuse victims, it can be in the form of a hyperlink, website URL encoded or having the victim click on malicious links and by redirecting them to a phishing website to install malicious code not the host machine or to append victims machine host file to change their local mappings

# Learning to Detect Phishing Emails

Even though there are few advantages to filter a phishing attack delivered in the form of an email, there are not that many methods tailored to concentrate on phishing emails as opposed to spams in general. The closely related option is to create policies on the smtp server based on the classification of what we call it as a good email vs a phishing email. As the attacks improve, we expect there will be new features that will be added which will help in identifying and combining the information form internal as well as external resources. This approach is used to detect phishing websites, or the content sent via email to lure a user. While most of the email gets filtered it is very hard to accurately differentiate, although 90% of the phishing emails are blocked there is still a 10% chance where the user can always fall into the trap

The prosaic approaches for phishing detections have always been at a lowest accuracy, machine learning provides us a better outcome for phishing detection, however, are time consuming and not a match at scale. There are various methods that can help us in Phishing detection (Khonji, 2013)

Machine Learning Based Phishing Detection

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Figure 2 Machine Learning

To tame ML and make it effective in detecting phishing attacks is to collect data at hand and they must have features related to legit websites and phishing websites. Figure 2 Machine Learning shows the working model of ML for phishing attack detection. A stream of data is provided as input to train ML model to help predict the phishing attacks and legit traffic (Gupta, 2016)

Author in El Asssal et al. introduced a conventional structure which is named after phish Bench, which enables us to not only analyze but also assess the current detection techniques by understanding the framework and performance measurements. The tests show us that the classification dropped when the portion dropped among the authentic and phishing decreasing from 1 to 10

### Hybrid Learning based Phishing Detection

The technique compares real and phishing with counter strategies like tokenization, word/text parsing and by stopping word evacuation, this type of approach has been found to be accurate against existing techniques (Abawajy, 2013)

### CRI approach to address phishing

This type of approach focuses on a solution resulting in a holistic anti phishing review. All the approaches primarily focus on how to prevent the attack without actually thinking about the crime and the respective problem associated with it, the following literature shows that providing solution without knowing/exploring the actual issue is not the right way to tackle the threat. As a reason to which a CRI approach was implemented to explore the crime factor, review mitigation techniques and investigate the missing pieces. The major goal is to provide a future researcher with the information at the same time strengthen the literature review. Crime has increased with the expansion of IT, IoT and any form of digital devices that can talk over the Internet where cyber criminals have got their hands on to exploit in the real world (Purkait, 2012)

### Taxonomy of phishing Attack

Attackers use different techniques for phishing. In social way they try to attract by sending emails to provide bank information, credit card and convenience them to respond. They might also include links to open which can directly hack your system and attackers can also remote to victim’s computer to collect all the data.

### Anti-phishing Technique Modus Operandi

After receiving phishing emails anti-phishing techniques are also implemented either by redirecting them to SPAM folder or by showing a warning when user tries to open the link (Vayansky, 2018)

### Lifecycle of Phishing Attack

* Attackers try to create a fake copy of organization and sends URL to all Internet users using email id & social networking sites.
* In case of fake emails there are different solutions to block them based on structure features of mails so that fake email ids are not blocked.
* If fake email id works and user tries to open link, there will be some browser techniques based on client end.
* If it by passes through all the blockages, then attacker can steal all the data from user.

### Visual Similarity Based Phishing Detection and Filtering Approach

A user will not understand phishing attack as it will look similar to legitimate sites by seeing high standard URL’s layout, Images, fonts. Fake and original sites look exactly same except the URL’s are not same, but user may not check URL’s before clicking the link. If attacker doesn’t match with the original website, then there are chances of users using it are very less. (Basit, n.d.)

An attacker can fool user by following

1. Visual Appearance: Phishing website will exactly look like original website as attackers will copy the HTML source code to look same.
2. Address Bar: They can also cover the address bar by using any image so that users will not understand.
3. Embedded Objects: Use of different images, text to hide the content from phishing detection techniques.
4. Favicon: Every website will have a unique favicon image and attacker will try to copy same image if not user can easily identify fake website.

Based on different surveys 90% of users couldn’t identify fake websites by seeing the visual appearance and content. Even experienced users cannot understand and most of them doesn’t even look at the address bar because of this most of the users are trapped by attackers. (El Aassal, 2020)

### Taxonomy of Phishing Detection and Filtering Based on Visual Similarity

Different approaches have been proposed to detect phishing attack based on user’s education and software. An educated user should always check address URL before clicking any link and software-based approach like black-list will have all phishing URL’s but fails as it’s difficult to update new websites that are created every day.

### Visual Similarity Assessment

Based on approach there are two modules in which first module will detect the suspicious URL’s and other module will detect the layout, content. In Block level each block is compared with original website and then it shows matching blocks. Layout level is dividing the total number of matching blocks to all blocks in original site. Overall style is calculated by style feature and similarity if threshold is more than legitimate website then it is considered as phishing webpage

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