Your Facebook Deactivated Friend or a Cloaked Spy (Extended Abstract)

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Abstract—With over 750 million active users, Facebook is the most famous social networking website. One particular aspect of Facebook widely discussed in the news and heavily researched in academic circles is the privacy of its users. In this paper we introduce a zero day privacy loophole in Facebook. We call this the deactivated friend attack. The concept of the attack is very similar to cloaking in Star Trek while its seriousness could be estimated from the fact that once the attacker is a friend of the victim, it is highly probable the attacker has indefinite access to the victims private information in a cloaked way. We demonstrate the impact of the attack by showing the ease of gaining trust of Facebook users and being befriended online. With targeted friend requests we were able to add over 4300 users and maintain access to their Facebook profile information for at least 261 days. No user was able to unfriend us during this time due to cloaking and short de-cloaking sessions. The short de-cloaking sessions were enough to get updates about the victims. We also provide several solutions for the loophole, which range from mitigation to a permanent solution

Keywords—Facebook, Social Network, Privacy, Cloaked Channel, Cloaked: Nonexistent, Decloaked: Reactivated

I.  INTRODUCTION

Facebook, the popular online social network, was founded by Mark Zuckerberg in 2004. Today it has over 750 million active users around the globe, half of whom login to the website on daily basis [1]. The average user has 130 friends, spends 60 minutes on the network every day and creates 90 pieces of content per month. 20 million new applications are installed by its users every day. In April 2010, Facebook launched its social plugin to integrate with other websites. Since the launch, 2.5 million websites have integrated into Facebook. In addition, Facebook provides a mobile platform used by 250 million people, who according to Facebook, are twice as active on the network as the non-mobile users. In 2010, Experian Hitwise named Facebook as the most visited website for the second consecutive year [8].

The large volume of data produced, and shared, the vast number of users, limited number of employees (The ratio of Facebook users to employees is approximately 250000:1 [1]) and its rapid success has not given the social networking site enough time to take care of all its privacy violations. One such point which is widely on the news, heavily researched academically and a cause of concern for Facebook officials, is the issue of Privacy of its users. The importance of the issue could be guessed from the very fact that a Google search, on November 7th 2011, returns 6.13 billion results for “Facebook”+ “Privacy” while it returns only 212 million results for “Iraq” + “war”. This simple Google search makes Facebook privacy 28.91 times more famous (or infamous) than the Iraq war. Note that, Google search results are not hundred percent accurate [12], they give an estimated value.

Employers have used Facebook to hire or fire employees on the basis of their behaviour on social networks [14]. Universities can screen applicants or ensure discipline by monitoring their students on social networks [4]. According to a survey by Social Media Examiner, 92% marketers use Facebook as a tool [16]. Phishers have improved their techniques by personalizing their schemes based on the data they acquire from social networks and are shown to be more useful than the traditional phishing schemes [9], [15]. A woman in Indiana (US) was robbed by a Facebook friend after she posted on her Facebook profile that she was going out for the night [13].

Facebook was initially launched as a student social network, its approach to privacy was initially network centric, which meant all data shared by users was visible to all the members of the network [17]. The privacy settings were changed several times till it reached the present form, where by default different levels of users information is visible to “Friends”, “Friends of Friends” and “Everyone”. Today, Facebook does allow the option of sharing the information only with the user through “Only Me” option in the privacy settings, in addition to applying exception of the rules to specific groups of people, called “lists”. It has been shown in the literature, that users rarely change the default settings [11], [8].

As Facebook’s default settings evolved to a level where not all information was visible to the user’s network, attackers and researchers tried to get information from what is publicly available. Since information uploaded by the users is expected to be shown to their friends only on Facebook [3], information flow (and so leakage) to friends is considered authorized. We analyze the impact of an attacker being able to be visible on the friendlist of a user temporarily and then hide beneath an invisibility cloak. This is the focus of this paper.

1This is only the extended abstract. For the full version of the paper please consult the proceedings of SESOC 2012, March 19, 2012 (IEEE PerCom Workshop 2012, March 19-23, 2012).
II. SUMMARY OF OUR CONTRIBUTIONS

A. Deactivated Friend Attack

Our deactivated friend attack occurs when an attacker adds their victim on Facebook and then deactivates her own account. As deactivation is temporary in Facebook, the attacker can reactivate her account as she pleases and repeat the process of activating and deactivating for unlimited number of times. While a friend is deactivated on Facebook, she becomes invisible. She could not be unfriended (removed from friend’s list) or added to any specific list. The only privacy changes that may apply to her are those applied to all friends or the particular list of which it is already a member.

This deactivated friend i.e. the attacker may later reactivate the account and crawl her victims profiles for any updated information. Once the crawling has finished, the attacker will deactivate again. While activated, the attacker is visible on the victim’s friend list. The concept here is very similar to that of cloaking in Star Trek where Badass Blink or Jem’Hadar has to uncloak (be visible), even if only for a moment, to open fire. Facebook provides no notification about the activation or deactivation of friends to its users.

1) Detection and restriction of the attacker as a friend:
As the attacker has to uncloak to spy, there is a probability of being detected and unfriended or put under restricted privacy policies. This probability will be dependent on several factors including the probability the victim checks their own friendlist (p1), the probability the user is online when the attacker is de-cloaked (p2), the probability the victim checks their profile page (p3), the probability the victim checks their friends preview (Facebook shows thumbnails and names of 10 friends on the left side of user’s profile page) (p4), the probability of the attacker being available on the friends preview (p5), the probability of the victim getting suspicious about the attacker after finding him on the friendlist and then attempting to restrict or unfriend her (p6), the probability that the victim will be able to apply the restriction before the attacker deactivates considering the time they both have (p7) and finally the probability of other factors (p8). For simplicity, assuming independence, the probability of the attacker being restricted is,

\[ p_r = p_1 p_2 p_3 p_4 + (1 - p_1) \prod_{i=2}^{8} p_i \]

To get a better insight into probabilities \( p_1, p_2, p_3 \) and \( p_4 \) we did a survey in which 76 people took part. In our survey, 48.5% participants selected 18:01-21:00 hours, while only 9.1% selected 00:01-06:00 hours as their most likely time to login to Facebook. The attacker may use this information and activate only when the user is least likely to login. The time zone of the user could be found from the current city details on the profile, if provided, or the locations details in status messages. 79% survey takers checked their friend list on less than 20% of the occasions when using Facebook. The low percentage of people checking the friend list is justified because Facebook allows searching for the friend of interest in the search box, so there is not much of a need to scroll down the friend list where on average a Facebook user has 130 friends. These friends in the list are arranged by alphabetical order based on their first names. Any name starting with a character close to the end of the alphabet will be less likely to be viewed by the user. Moreover, 74.4% users checked their profile page less than 51% of the times they used Facebook. This high percentage does not check their Facebook profile page because when a user logs in to the social networking website, the default page is the home page. The home page is the epicenter of most social things including the newsfeed and events. The user is also given an option to update her status from the home page. Moreover, any notifications give a direct link to the comment or activity. All these things make the users own profile page less attractive to being checked often. Furthermore, the survey showed 50% people claimed to glance 20% or less times at their friends preview when they check their profile page. Eyetracking analysis could give further insight to the correctness of this percentage distribution. With a repeated use of Facebook, the user’s mind is trained to search for new information in the center of the page, where the messages, videos, photos etc, are posted. The scroll bar is on the righthand side, making it a better place for the advertisements to be placed. The friends quick view is on the lefthand side, so it is not the most likely place to catch attention. But attention might also depend on other factors like the colors on the page, the details of the pictures available etc. A photo that could mix more with the background might not be that attractive or eye catching. Similarly, the use of a network name under the name of attacker might change the probability of eyes getting attracted to the friend in the preview. Moreover, different names may have different impacts.

Probability \( p_5 \) is also not very hard to estimate. Out of the 10 friends shown on the preview roughly 7 are those with whom the user has recently interacted on Facebook. The remaining 3 friends for the preview will be selected randomly (Facebook friend preview algorithms are not public, these results are estimated from our observation). Having 130 friends on average, the likelihood of the attacker ending up on the friends list is, roughly 3/130. The Friend preview is cached by Facebook, so once the user logs in, the same 10 friends are displayed in random order.

The attacker may use multiple pseudonyms to be present as several deactivated friends on the victims profile so removal or identification of one of the attacker profiles might still undermine privacy.

2) Seriousness of the attack: The attack is very serious for several reasons. First, it is very hard to detect this attack. The attacker can activate her account at the moment least likely to be detected and crawl her victims profile for information, keeping an updated record. Various groups of information aggregators including marketers, background checking agencies, governments, hackers, spammers, stalkers and criminals would find this attractive as a permanent back door to the private information of a Facebook user, once befriended. Secondly, a user may not be privacy conscious initially but, with the large media coverage or personal experience become much more concerned. Then, they may want to adjust his privacy settings on social networks like Facebook. With this attack, and the attacker being cloaked, the victim will not be able to
apply any updates, unless they are applied to all friends, or to lists of which the attacker is a member. Thirdly, when the attacker can closely monitor a few users on Facebook, they can get a deeper insight into a large network. The attacker could be a cloaked spy monitoring and analyzing them. Facebook recently added the feature of browsing friendships. This would help the attacker in analyzing the bond between two of his victims by browsing their friendship which provides information including the month and year since when they are Facebook friends, the events they both attended, their mutual friends, things they both like, their photos, the messages they wrote on each others wall, etc. This would give a very deep insight about the level of their relationship, the duration when they were more or less interactive, etc. This information could be used for several attacks including social engineering and social phishing attacks.

3) Being befriended at the first place: The attacker requires to be friends with his victim in the first place. This could be done in many different ways. The attacker could send a random friend request and see if accepted. She could create the profile of a famous scientist e.g., someone has made the profile of Claude Shannon and has got 156 friends. There are Facebook profiles made for animals. Psychologically we do not feel a threat from some animals, so if profiles for them are made on Facebook then users will feel less threatened. Also, the attacker could use social engineering by pretending to be an acquaintance or real life friend of the victim, but not yet a Facebook friend. Another approach would be to pretend to be someone the victim met at a conference or during a social event. By default, Facebook uses encryption only for login, so a man in the middle attack or session hijacking is not very difficult. The attacker could use this technique to take over a session, accept himself as a friend, remove the notification of friendship (to avoid suspicion) and then deactivate the attacking account. Other possible attacks could include using clickjacking to be automatically accepted as a friend, the traditional use of keyloggers, OS vulnerabilities, browser vulnerabilities, smart phone hacks, etc.

4) Experimental Results: To prove the ease of being befriended on Facebook we ran an experiment for 606 days. The experiment was divided into three phases: the first phase was targeting befriending of users, the second phase was getting into the cloaked mode and temporarily de-cloaking for updates and the third phase was permanent de-cloaking to see how many users unfriend a stranger (whom they once added).

a) Phase 1: We created a Facebook account under a pseudonym, for experimental purposes, on February 15, 2010. For the first 99 days we requested 225 users to be friends on Facebook, out of which 90 people accepted our request. During this time we did not allow other users to add us as friends. We wanted to get closer to the circles of our potential targets and did not want other random requests. On the 100th day, we started accepting requests from other people. With the acceptance of friend requests our probability of being accepted by our desired group kept increasing. During the course of 285 days of phase 1 of the experiment, we sent 595 friend requests out of which 370 were accepted, resulting in an average success rate of 62%. We received a total of 3969 requests from day 100 till day 285 which are 6.67 times more than the number of requests we sent. Till Day 285 we had added 4339 users as friends. This is when we decided to move to phase 2 of the experiment.

b) Phase 2: In phase 2 of the experiment we went into the cloaked mode with temporary de-cloaking to get updates about our friends on Facebook. The phase continued for a total of 261 days with de-cloaking at regular intervals. We de-cloaked for only 10 minutes in each session, which is enough time to crawl hundred of profiles. We were able to observe all our Facebook friends during the de-cloaking except those who had deactivated their accounts and were in the cloaked mode. None of our friends could technically have, unfriended us during this phase.

c) Phase 3: The first and second phase of the experiment took a long time and with the awareness about privacy increasing we expected that users will remove strangers from their friendlist, once they are given an option. So, we left the account in de-cloaked mode, with no activity, for 60 days. We noticed a shrink of 239 users in our friendlist. This may indicate that about 5.5% people got privacy conscious with the extended awareness and started removing strangers from their friendlists.

5) Reflections and Ethical consideration: As mentioned in the work by Boshmaf et. al. [6], very low risk experiments are the only way to analyze the real world impact of such vulnerabilities in social networks used by hundreds of millions of users.

Ethics of the research were strongly considered during the experimental phase. We did not save any identifiable personal information. We will apologize to all those who took part in the study, delete the account before the end of the conference and inform Facebook to fix the vulnerability.

Moreover, the use of pseudonyms can be considered as a measure of remaining anonymous which is protected by the first amendment of the constitution of the United States, in the context of freedom of speech e.g., [2], [10]. This raises an important question whether organizations like Facebook or, until recently, Google were following the law when preventing users from using measures of anonymity for the use of their respective social networks. Further discussion of the topic is beyond the scope fo the paper.

B. Solutions

We now provide some solutions to the attack,

- Users should be notified about the activation and deactivation of their friends. Using this a user may report any suspicion to Facebook.
- Flag the users who activate and deactivate their accounts several times. Then they could be further monitored for any
suspicious activities and permanently banned by Facebook. Alternatively, if users are notified about the activation and deactivation of the accounts of their friends, then a Facebook application can be developed which monitors such changes and automatically jails (reduces the view of a victims account) a person during the short span of de-cloaking or even unfriend them.

- The deactivated friends should still be visible in the users friend list (may be blurred) such that the privacy settings applied to them maybe changed. It should also be made possible to remove them from the friend list.
- Permanent deactivation of accounts with no reactivation as is done in Google+, Orkut and Twitter can be another alternative.

III. CONCLUSION

In this paper we presented a privacy loophole in Facebook in which the attacker temporarily deactivates his account to avoid detection and removal from the friend list, but reactivates to crawl the victims data. We also discussed the impact of the attack, the possibility of it being detected and the possible groups of users who may be interested in using this attack. To support our claims of ease of targeted befriending of users on Facebook we conducted an experiment where on average 62% of our friend requests were accepted. We tested the cloaking attack for 261 days and none of our Facebook friends unfriended during the course. We conducted a survey to get further insights into the user’s behavior and make the attack more stealthy. Finally, we provided some recommendations about possible solutions to the problem. We wonder whether other cloaked channels exist.

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