Detection of Malware Intrusion during Application Update in Android

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Abstract: ***Android is a popular mobile device platform developed by Google. Android Application is now part of our day to day life, and there are several confidential data store in mobile devices. Most of the Android users are unaware about security of data and therefore many users' data is unsecure. Recently, the threat of Android malware is spreading rapidly. Therefore several Android Applications are defected by malware. Defected apps manipulate personal information such as SMS messages and Contacts, and leakage of such information may cause great loss to the android users. Till now we have solution for finding repackaged application. But these mechanisms are not capable to finding update attack. In update attack malware code are placed in android application at a time of application update. Therefore static methods are not capable for it.***

Keywords: Android, Malware, Android Apps, Security

1. Introduction

Android operating devices becomes more and more popular in the past three year. Unfortunately, the increasing adoption of smart phone comes with the growing of mobile malware. A recent report from IDC [1] shows that there are 722 millions of Smartphone sold in 2012, among them 497 millions of Smartphone have android operating system. Another report from Appbrain [2] mentions that the android market surpassed 850000 app mark in December 2013. Unfortunately, such popularity also attracts the malware developers. Recent survey report from Juniper [3] alert that there is "614 percent increase in Android-based malware from march 2012 to march 2013". In android devices sensitive information are sent to unknown destination without user awareness. Thus privacy and security of data is become more important.

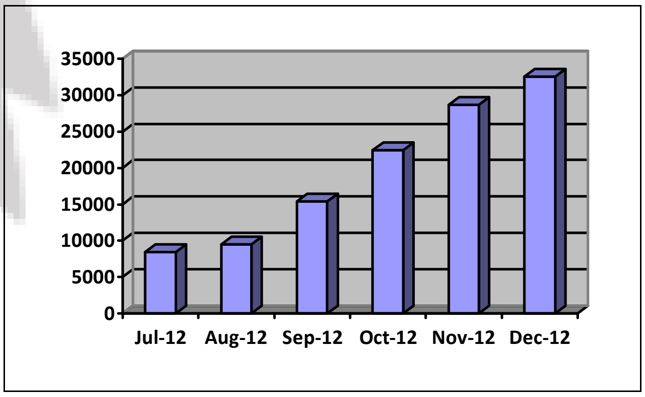
Resolve the tension between fun and usefulness of third-party applications and risks of privacy they pose is a critical challenge for the Android platform. Mobile OS currently provide that application uses of private information or not. But they did not say where this information actually used.

The Repackaging technique typically piggybacks the whole malicious payloads into application, which could potentially depiction their presence. The update attack technique makes it difficult for detection. Specifically it may still repackage popular apps, but instead of enclosing the payload as a whole, it only includes an update component that will fetch or download the malicious payload at runtime [5].

Therefore we develop mechanism that check update component in each apps and check whether that component download from official app store or not. If download from third party apps store then alert to mobile user.

2. Time Line of Android Malware

Android is attractive an increasingly appealing target for cyber criminals [4]: in the second half of the year 2012, a new malware strain for the smart operating system was excogitation every two minutes. During that period, G Data Security Labs Finds almost 140,000 new malicious files – five times as many as in the preceding six months. With regard to Android malware, the perpetrators have been mainly relying on Trojan horses and tried and tested eCrime strategies. This involves using manipulated copies of known apps and applications with actually legitimate functions, such as apps claiming to be weather apps.



3. Related Work

We are present a logical characterization of existing Android malware, ranging from their installation, activation, to the carried malicious payloads [5].

A. Malware installation

By manually analysing malware samples, we classify into three main social engineering-based techniques, i.e., update attack, repackaging, and drive-by download. These techniques are not manually exclusive as different variants of the same type may use different techniques to entice users for downloading [5].

1. Repackaging

Repackaging is one of the most ordinary techniques, in that malware authors use to piggyback malicious payloads into popular applications. In essence, malware authors may locate and download popular apps, disassemble them, enclose malicious payloads, and then re-assemble and submit the new apps to official and/or alternative Android Markets. Users could be vulnerable by being enticed to download and install these infected apps. To quantify the use of repackaging technique, we take the following approach: if a sample shares the same package name with an app in the official Android market, we then download the official app and manually compare the difference, which typically contains the malicious payload added by malware authors. If the original app is not available, we choose to disassemble the malware sample and manually determine whether the malicious payload is a natural part of the main functionality of the host app. If not, it is considered as repackaged app.

2. Update Attack

The first technique typically piggybacks the entire malicious payloads into host apps, which could potentially expose their presence. The second technique makes it difficult for detection. Specially, it may still repackage popular apps. But instead of enclosing the payload as a whole, it only includes an update component that will fetch or download the malicious payloads at runtime. As a result, a static scanning of the host apps may fail to capture the malicious payloads. Apparently, the stealthy natures of these update attacks poses significant challenges for their detection.

3. Drive-by Download

The third technique applies the usual drive-by download attacks to mobile space. Though they are not directly exploiting mobile browser vulnerabilities, they are basically enticing to download "interesting" or "feature-rich" apps.

B. Activation

Activation of android malware relies on particular event. Among all available system events, BOOT_COMPLETED is the most attracted one to existing android malware.

C. Malicious Payloads

As existing Android malware can be largely characterized by their carried payloads, Partition the payload functionalities into four different categories: remote control, privilege escalation, financial charges, and personal information stealing.

1. Privilege Escalation

The Android platform is a complex system that consists of not only the Linux kernel, but also the entire Android framework with more than 90 open-source libraries included, such as WebKit, SQLite, and OpenSSL. The complexity naturally introduces software vulnerabilities that can be potentially exploited for privilege escalation.

2. Remote Control

We also observe that some malware families attempt to be stealthy by encrypting the URLs of remote C&C (Command and Control Server) servers as well as their communication with C&C servers. We also find that most C&C servers are registered in domains controlled by attackers themselves. However, we also identify cases where the C&C servers are hosted in public clouds.

3. Financial Charge

One profitable way for attackers is to secretly subscribe to (attacker-controlled) premium-rate services, such as by sending SMS messages. On Android, there is a permission-guarded function sendTextMessage that allows for sending an SMS message in the background without user's wakefulness. Moreover, some malware choose not to hard-code premium-rate numbers. Instead, they leverage the flexible remote control to push down the numbers at runtime.

4. Information Collection

In addition to the above payloads, we also find that malware are actively harvesting information from the infected phones, including SMS messages, phone numbers as well as user accounts. We consider the collection of users' SMS messages is a highly suspicious behavior. The user credential may be included in SMS messages.

4. Existing Detection Mechanism

Android Application model has several interesting features. First, application must follow a specific structure, i.e., they must be composed of some basic kinds of components understood by android. This design encourages sharing of code and data across application. Next, interaction between components can be tightly controlled. By default, components inside an application are sandboxed by android, and other applications may access such components only if they have the require permission to do so. This design promises some measure of protection from malicious application. However, enforcing permission is not sufficient to prevent security violation, since permission may be misused, intentionally or unintentionally, to introduce insecure data flow [6].

There are two methods about automatic detection of android malware.

A. Misuse Detection

Misuse Detection is signature-based approach by matching the rules and policies. The advantage of this approach is that it has high accuracy. But it is invalid to the new android malware [7]. Fuchs et al [8]. Propose ScanDroid that extracts security specifications of the application, and apply data flow analysis to check if any of data flows violate them.

B. Anomaly Detection

Anomaly Detection is different from misuse detection. It usually applies machine learning algorithms for obtaining the known malware behavior and predicting the unknown or new malware. But it sometimes cause high false positive [9]. Iker Burguera et al [10]. Propose Crowdroid that analyzing data collected of traces from an unlimited number of real user based on crowd sourcing. Crwdroid framework has been demonstrates by analyzing the data collected in the central server.

There are two common analysing methods to investigate the structure and behaviour of android malware.

A. Static Analysis

The static analysis method only considers the contents of every application after decompiling the code [3]. This method can reduce the cost and improve the performance, but it will face the great difficulty when meeting the code obfuscation technique [9]. Wei Tang et al. [11] propose ASESD that measures the dangerous level of certain permission combination presentation. Fuch et al. [8] propose ScanDroid for automated security certification of Android applications. It analyses data policies in application manifest and data flows across content providers.

Dong-Jie Wu et al [7] propose DroidMat a static feature-based mechanism to provide a static analyst prototype for android malware detection with the consideration of detection effectiveness and cross-version capable analysis. The mechanism considers the static information including permissions, Intent messages passing, deployment of components and API calls for characterizing the Android applications behaviour. In order to recognize different intentions of Android malware, different kinds of clustering algorithms can be applied to improve the malware modelling capability.

B. Dynamic Analysis

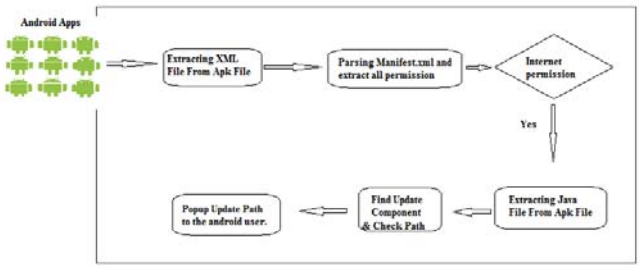
The dynamic analysis method continuously monitors the various running situation of the malware (such as reading and writing operations, API calls, power consumption, incoming and outgoing network information, and so on) and then constructs some models for detecting malware. However, it is subjected to high cost in deployment and manual efforts [9].

1. Logged behavior sequence: Zhao et al. [12] propose AntiMalDroid to detect Android malware that use logged behavior sequence as the feature, and construct the models for further detecting malware and its variants effectively in runtime. They also extend malware features database dynamically.
2. System calls: Burguera et al[10]. Propose Crowdroid that traces the system calls behavior, converts them into feature vectors, and applies k-means algorithm for detecting malware.
3. Dynamic Tainting Data flow and Control flow: Enck et al. [13] propose TaintDroid, an extension to the Android mobile-phone platform that tracks the flow of privacy sensitive data through third-party applications.

5. System Model

Android is continues to be a primary target for malware attacks due to its market share and open source architecture. Resent survey says that there are more than 500 third party app stores containing malicious apps [14]. In update attack technique attacker repackage popular apps, but instead of enclosing the payload as a whole, it only includes an update component that will fetch or download the malicious payload at runtime from third party app store.

We develop a mechanism that find the update component code from java file. First we extract XML file from Apk file, and parse Manifest.xml file and check whether application have internet permission or not. If application have internet permission then and only require checking a java file. In java file we check path and if path have URL of third party app store then alert to mobile user.


Android Apps
Extracting XML File From Apk File
Parsing Manifest.xml and extract all permission
Internet permission
Yes
Extracting Java File From Apk File
Find Update Component & Check Path
Popup Update Path to the android user.

6. Solution

In this development, there are several components that perform individual task. First, we have developed mechanism that convert Apk file into XML File. After that we apply parsing on Manifest file and finding a list of permission from it. Attacker downloads malicious code if and only apps have internet permission. So we check permission list and if there is a internet permission then we check java file. In java file we check update component code. In that code, there is a URL where the update component is placed. If URL have a third party apps store location then popup one message to user.

7. Experimental Result

In this section we provide the detailed results of the experiments carried out using the proposed framework. We test our system with self written malware. We have ten self written Apps among them some apps download update component from official apps store where rest are download from third party apps store.

Apps	*Detection*				Accuracy
	TP	*FN*	*FP*	*TN*	
Benign apps	-	-	1	4	0.70
Malicious Apps	3	2	-	-	

TP-Malware correctly detected
FN-Malware not correctly detected
FP-Benign apps consider as a malware
TN- Benign Apps correctly classified

8. Conclusion

There are emerging lots of android malware on android platform. They are very harmful to user. So how to detect android malware quickly and effectively is urgently required and facing big challenge. We represent a mechanism that finds a URL path from update component from java file and check that URL and alert to user that update of your application from third party apps store.

Some modification is required in existing malware detection mechanism or may develop malware detection mechanism to detect repackaging as well as detect malware apps which download malware code at update time.

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