Vaccinating Android

BalCCon2k14 edition

#/viris[# *]

/WhoAreWe

> Just two guys from Ex-Yu

> Having fun breaking stuff

> Love to play with apps

> Specialized in app security

> Only 6 hours to get here


BalCOon
BALKAN
COMPUTER

Famous .si people

#/viris[# *]

THE FBI FEDERAL BUREAU OF INVESTIGATION

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Home • News • Press Room • Press Releases • FBI, Slovenian and Spanish Police Arrest Mariposa Botnet Creator, Operator

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FBI, Slovenian and Spanish Police Arrest Mariposa Botnet Creator, Operators

Washington, D.C.
July 28, 2010

FBI National Press Office
(202) 324-3691

The FBI, in partnership with the Slovenian Criminal Police and the Spanish Guardia Civil, announce today significant developments in a two-year investigation of the creator and operators of the Mariposa Botnet. A botnet is a network of remote-controlled compromised computers.

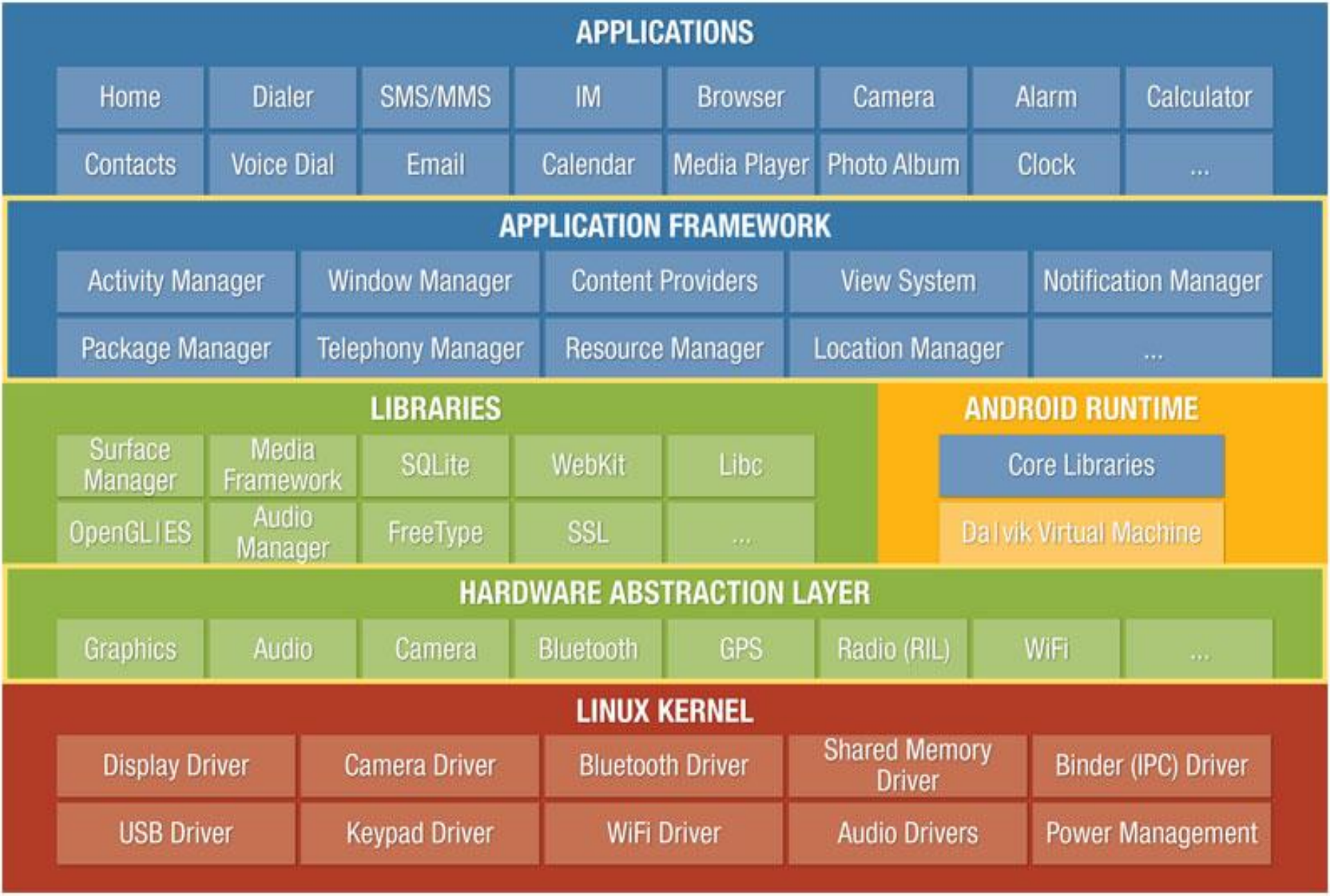
The Mariposa Botnet was built with a computer virus known as "Butterfly Bot" and was used to stea passwords for websites and financial institutions. It stole computer users' credit card and bank account information, launched denial of service attacks, and spread viruses. Industry experts estimated the Mariposa Botnet may have infected as many as 8 million to 12 million computers.

"In the last two years, the software used to create the Mariposa botnet was sold to hundreds of oth criminals, making it one of the most notorious in the world," said FBI Director Robert S. Mueller, I "These cyber intrusions, thefts, and frauds undermine the integrity of the Internet and the business that rely on it; they also threaten the privacy and pocketbooks of all who use the Internet."

Agenda

> Android mobile apps
> Short 101 APK
> Analysis (static, dynamic)
> Vaccinating APK, Android
> DEMO(s)
> The end


WHERE
ARE
WE?
TODAY


APPLICATIONS
Home
Dialer
SMS/MMS
IM
Browser
Camera
Alarm
Calculator
Contacts
Voice Dial
Email
Calendar
Media Player
Photo Album
Clock
...
APPLICATION FRAMEWORK
Activity Manager
Window Manager
Content Providers
View System
Notification Manager
Package Manager
Telephony Manager
Resource Manager
Location Manager
...
LIBRARIES
Surface Manager
Media Framework
SQLite
WebKit
Libc
OpenGL | ES
Audio Manager
FreeType
SSL
...
ANDROID RUNTIME
Core Libraries
Dalvik Virtual Machine
HARDWARE ABSTRACTION LAYER
Graphics
Audio
Camera
Bluetooth
GPS
Radio (RIL)
WiFi
...
LINUX KERNEL
Display Driver
Camera Driver
Bluetooth Driver
Shared Memory Driver
Binder (IPC) Driver
USB Driver
Keypad Driver
WiFi Driver
Audio Drivers
Power Management

#/viris[# *]

Status 2013/2014

HP research finds vulnerabilities in 9 of 10 mobile apps

Summary: *Obvious security vulnerabilities are disturbingly common in corporate mobile apps. If HP can find them, so can malicious actors.*

By Larry Seltzer for Zero Day | November 19, 2013 -- 13:15 GMT (05:15 PST)

Follow @lseltzer

Tests run by HP Fortify, the company's enterprise security arm, indicate that 90% of mobile apps have at least one security vulnerability.

The company used their Fortify On Demand for Mobile product to test the security posture of 2,107 applications published by 601 companies on the Forbes Global 2000. Only iOS apps were tested, but HP says that there is good reason to believe the same problems exist in any Android counterparts.

Overall, the problems fell into one of four categories. The analysis showed that 86% of apps that accessed potentially private data sources, such as address books or Bluetooth connections, lacked sufficient security measures to protect the data from access.

86% of apps tested lacked binary hardening protection. This refers to a group of techniques, many implemented simply with checkboxes at compile time, which protect against certain attacks, like buffer overflows, path disclosure and jailbreak detection.

Featured news

- Malicious and risky apps on Android and iOS
- Coursera privacy issues exposed
- HealthCare.gov breach affected test server, not users
- Researchers compile list of Android apps that allow MitM attacks
- Profit leads motives for malware engineers
- 91% of Americans have privacy concerns
- OS X version of Windows backdoor spotted

Researchers compile list of Android apps that allow MitM attacks

Posted on 05 September 2014.

Around 350 Android apps that can be downloaded from Google play and Amazon stores fail to properly validate SSL certificates for HTTPS connections, and thus open users to Man-in-the-Middle attacks if they use them on insecure and open networks, a researcher with the CERT Coordination Center at the Software Engineering Institute at Carnegie Mellon University warned.

The vulnerable apps have been discovered via automated testing using the CERT Tapioca testing appliance, and the researchers keep a list of these updated - among them are OKCupid's official app, (ironically) a number of security apps, but most worryingly, a number of e-commerce (sucha as an eBay app for German users) and e-banking apps.

The list is not yet complete. The setup created by the researchers tests only one application at a time, and the testing started only a few weeks ago.

Things

- There is a (big) need for testing mobile apps
- Mobile app development feels like late 90's development
- Our experience?

101 APK, Android

> APK? WTF?

> Get APK

> Decompile and analyze code

> Test

> Exploit

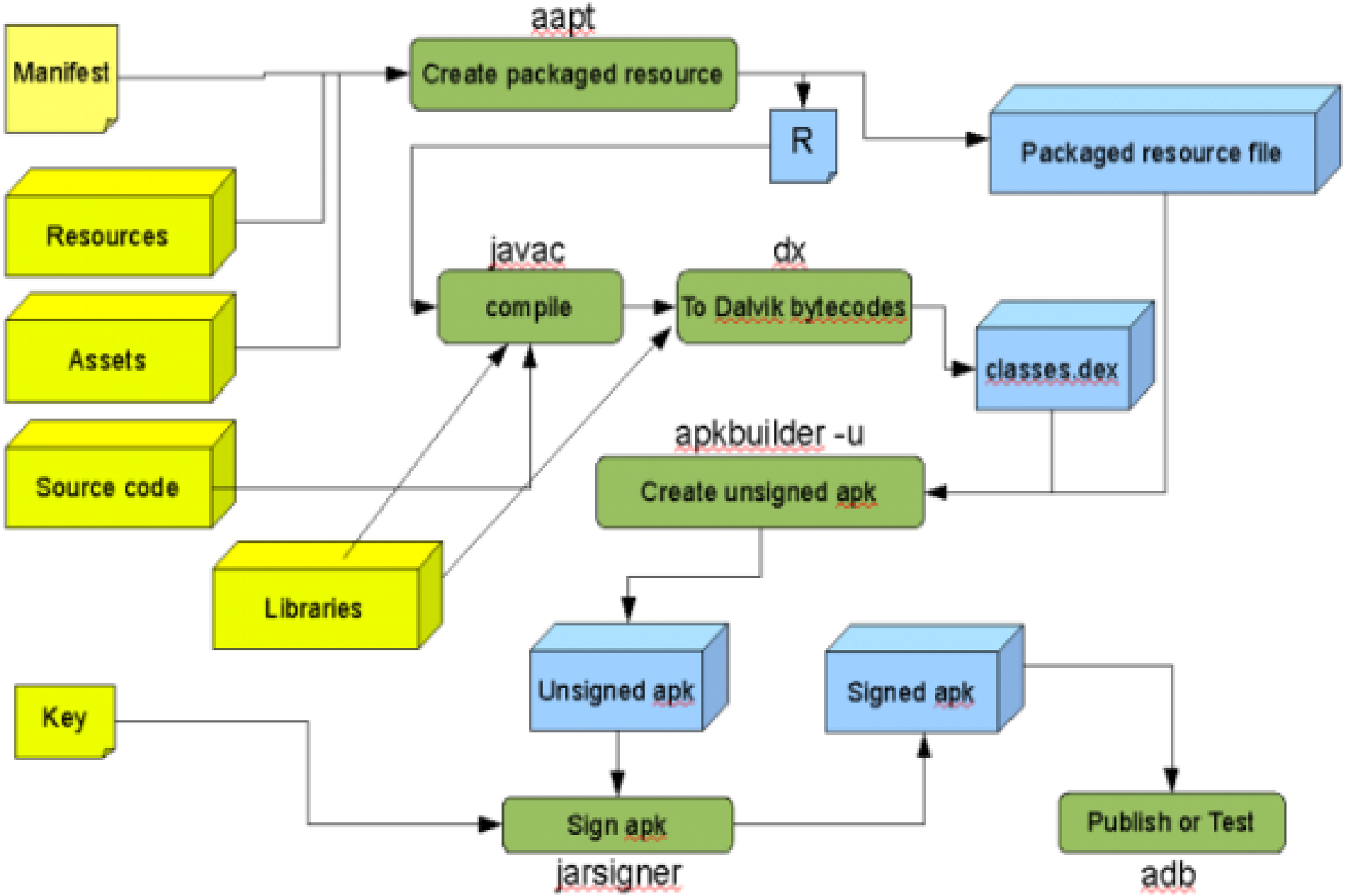
APK?

> Android application package file (**APK**) is the package file format used to distribute and install application software and middleware onto Google's Android operating system, and certain other operating systems, such as Blackberry 10 Devices with the OS version 10.2.1.

Wikipedia

Android Applications

- .apk (Android Package) format
- Nothing more than a zip
- Written exclusively in Java, with native libraries in C/C++.
- Composed of components like Activities, Services, Broadcast Receivers, etc.


aapt
Manifest
Create packaged resource
R
Packaged resource file
Resources
javac
dx
compile
To Dalvik bytecodes
Assets
classes.dex
apkbuilder -u
Source code
Create unsigned apk
Libraries
Unsigned apk
Signed apk
Key
Sign apk
Publish or Test
jarsigner
adb

Getting APK

> Copy from the phone
> Copy from the backup
> Adb pull
> http://apps.evozi.com/apk-downloader/
> Download from untrusted source ;)

Decompile

> Pull from phone.

```
adb pull /data/app(or app-private)/app1.apk
unzip app1.apk
dex2jar classes.dex
jdgui classes2jar.jar
```

or convert to smali and then analyse the code

```
adb pull /data/app/app1.apk
unzip app1.apk
java -jar baksmali.jar -o C:\pentest\app classes.dex
```

Tools used for reversing APK

> Dex2Jar
> JD-GUI
> (Back)smali
> APKTool

> http://www.decompileandroid.com/

Short demo

What to check?

- Transport security
  - Plaintext Traffic
  - Improper session handling
  - Validate SSL certificates
- Compiler protection
- UIWebviews
  - Data validation
  - Analyze UIWebView implementations
- Insecure data storage
  - SQLite DB
  - File caching
  - Checking log files

What to check? (cont)

- Logging
  - Custom logs
  - Crash reports logs and files
- Binary analysis
  - Disassemble/decompile the application
  - Detect obfuscations
  - Detect anti-debugging protections
- Client side injections
- Third party libraries

Testing app

> Start simulator with proxy

> Install app in emulator or device

> Use Wireshark, Fiddler &/|| Zap &/|| Burp to monitor network

> Run app

> See logs, dump, crashes, files

Request

Target | Proxy | Spider | Scanner | Intruder | Repeater | Sequencer | Decoder | Comparer | Options | Alerts

Intercept | History | Options

Filter: Hiding CSS, image and general binary content

#	Host	Method	URL	Params	Modifi...	Status	Length	MIME type	Extens
72	http://adserver.fugo.mobi	GET	/ads/geomap.php?platform=and...	✓		200	255	text	php
73	http://mob.adwhirl.com	GET	/getInfo.php?appid=f3743c9b9c1...	✓		200	588	JSON	php
74	http://i.w.inmobi.com	POST	/showad.asm	✓		200	1541	XML	asm
77	http://met.adwhirl.com	GET	/exmet.php?appid=f3743c9b9c1...	✓		200	119	HTML	php
78	http://kelimeavisl.fugo.mobi	GET	/servicesV2_SL/info.php?nudid=...	✓		200	905	text	php

Request | Response

Raw | Params | Headers | Hex

```
GET
/servicesV2_SL/info.php?nudid=354406042390139b4:07:f9:8d:6b:83&udid=354406042390139&agent=android_3&ver=3.1.3
&hash=499eebfd23d007af336cd04f44c50ffc HTTP/1.1
User-Agent: Dalvik/1.6.0 (Linux; U; Android 4.2.2; GT-I9000 Build/JDQ39E)
Host: kelimeavisl.fugo.mobi
Connection: Keep-Alive
Accept-Encoding: gzip
```

Reply

Target | Proxy | Spider | Scanner | Intruder | Repeater | Sequencer | Decoder | Comparer | Options | Alerts

Intercept | History | Options

Filter: Hiding CSS, image and general binary content

#	Host	Method	URL	Params	Modifi...	Status	Length	MIME type	Extens
72	http://adserver.fugo.mobi	GET	/ads/geomap.php?platform=and...	✓		200	255	text	php
73	http://mob.adwhirl.com	GET	/getInfo.php?appid=f3743c9b9c1...	✓		200	588	JSON	php
74	http://i.w.inmobi.com	POST	/showad.asm	✓		200	1541	XML	asm
77	http://met.adwhirl.com	GET	/exmet.php?appid=f3743c9b9c1...	✓		200	119	HTML	php
78	http://kelimeavisl.fugo.mobi	GET	/servicesV2_SL/info.php?nudid=...	✓		200	905	text	php

Request | Response

Raw | Headers | Hex

Content-Length: 448
Date: Sat, 30 Nov 2013 11:14:15 GMT
X-Varnish: 1695575935 1695575798
Age: 1
Via: 1.1 varnish
Connection: keep-alive

**MBBXwfrbrAa13O7KDIgf7MZyEZbOhng5RgoO7Yhdw3Hs8izrSikFh27erHJf1svP3FreJctH1qnfNIPAgJ8lNXd5Zzjo
2KlPnAvhhPzRAArT83K/jlVBO4G6+FKstjDOF/0e9SWYhA9CzwIy3kNGUBmfNGaivh1OhXAiUHNBDMYSpXAQrAdh
+Rxl5+3LMnELTP5g8uFTwilUBiu1J/Ulve2Ns+CGX/erwJEARQb2105ZhaWzQVb7TPpvMVZFuCthCJMvTMHdQXjvbJI
azphblIPqUENGT9ifW8BPbe9JycBUGX58NGpgEyJ13dVLiDuEXsDyD7x+4n7th+anuDv3NFv4R991T2LItUmdB7fr8
KZshJ/TEk7/P1xrghaT7f1oV**

Other tools

> http://dexter.dexlabs.org/

DEXTER | My Projects | Documentation | Hello Andy

General

Go to: Notes | Used permissions | Defined permissions | Activities | Services | Broadcast receivers | Content providers

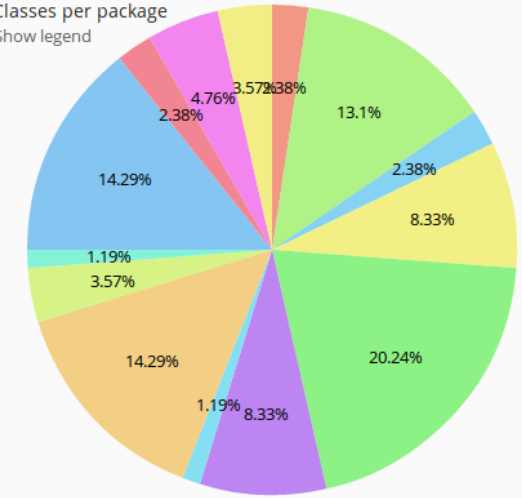
General Analysis Information

PROPERTY	VALUE
Filename	08CFFA8F55BE4BBED2704395876B618F_2.zip
App package name	com.android.services
Version	351
Minimum SDK Version	7
Target SDK Version	
Checksum	08cffa8f55be4bbed2704395876b618f
Developer	['Bad Signature']
Shared UID	

Program statistics

Classes per package | Basic blocks per package | Obfuscated vs. unobfuscated packages | Internal vs. external packages

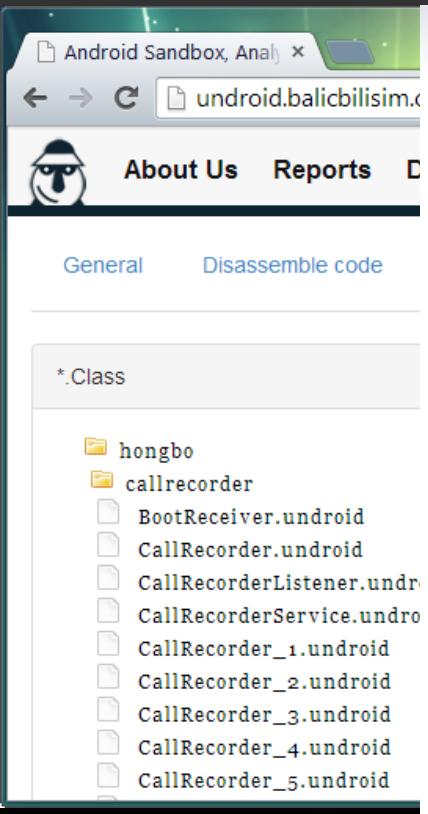
Classes per package
Show legend



#/viris[ ]

Other tools

> http://undroid.balicbilisim.com/



Security Researcher Accidentally Crashes Google Play When Testing POC App

SHARE: SHARE SHARE TWEET

Adjust text size:

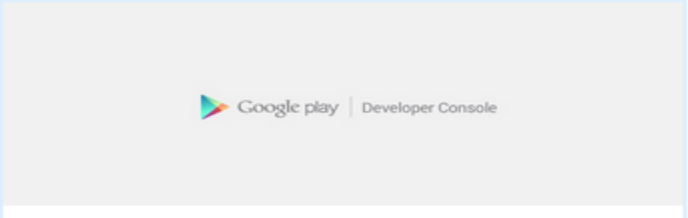
Turkish security researcher Ibrahim Balic claims to have found an Android vulnerability that could lead to memory corruption. While testing his findings, he may have crashed Google Play a couple of times.

According to the expert, Android 2.3, 4.2.2 and 4.3 are certainly affected, but he believes that all versions of the operating system are vulnerable.

He has found that executing a malformed APK file leads to a denial-of-service (DOS) condition and the device freezes. Balic wanted to test his theory against Bouncer, the Android anti-malware system developed by Google, so he uploaded a malformed APK file to Google Play.

Shortly after, he started getting errors on Google Play. In addition, during the time he performed his tests, many people reported being unable to upload applications to Google's app market.

"I think it was probably because of testing my PoC exploit on Google Play," Balic noted in a blog post.



- Google Play Developer Console crashes during te...

Static analysis

- You need to know how read Java code
- Cannot see all runtime replies
- Obfuscated, renamed?
- Identify important segments in code

```
amString1, String paramString2)

ML("http://my-own-gamme.com/api/save.php?t=" + paramString1 + "&u=" + paramString2);
);
lueOf(false);

true);
```

```
public class HttpCall
{
  private static String SECURITY_TOKEN = "AE94DFKMADF4U94MNSDF324SF3ADASCAR4GASDFF94";
  private CookieStore cookieStore = new BasicCookieStore();
  private HttpClient httpClient = new DefaultHttpClient();
  private HttpContext localContext = new BasicHttpContext();

  public HttpCall()
  {
    this.localContext.setAttribute("http.cookie-store", this.cookieStore);
  }

  // ERROR //
  public String call(String paramString)
  {
    // Byte code:
    //   0: new 52   org/apache/http/client/methods/HttpPost
    //   3: dup
    //   4: aload_1
    //   5: invokespecial 55   org/apache/http/client/methods/HttpPost:<init>  (Ljava/lang/String;)V
    //   8: astore_2
    //   9: aload_2
    //   10: ldc 57
    //   12: getstatic 18   com/ttech/turkcellsdk/util/HttpCall:SECURITY_TOKEN  Ljava/lang/String;
    //   15: invokevirtual 61  org/apache/http/client/methods/HttpPost:setHeader   (Ljava/lang/String;Ljava/lang/String
    //   18: aload_0
    //   19: getfield 26   com/ttech/turkcellsdk/util/HttpCall:httpClient  Lorg/apache/http/client/HttpClient;
    //   22: aload_2
```

```
#/viris[
```

Dynamical analysis

- Monitoring/changing traffic with proxy
- Debugging
- Reflection

Reflection

- "Reflection" is a language's ability to inspect and dynamically call classes, methods, attributes, etc. at runtime.
- Java looking Java

Debugging vs Reflection

- Higher level view
- Better idea how application works
- Java like access to objects, methods, variables
- Interaction with application

Features

- Access all variables
- Change values of variables
- Call methods
- Use variables and scripts
- Use full BeanShell
- Write Java code

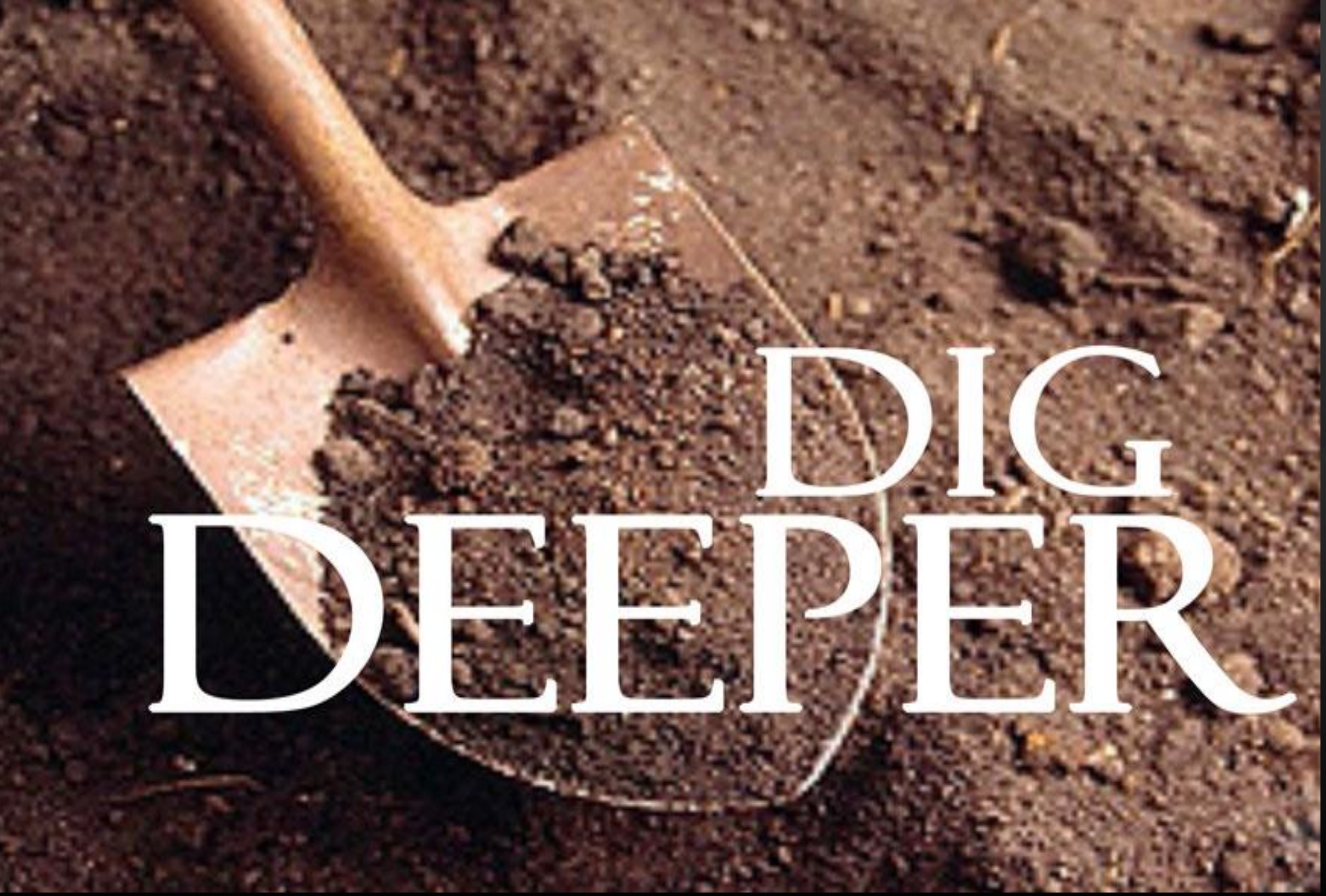
BeanShell

- Java Interpreter
- Scripting Language
- Small
- Embeddable / Extensible
- A natural scripting language for Java

What do we see..

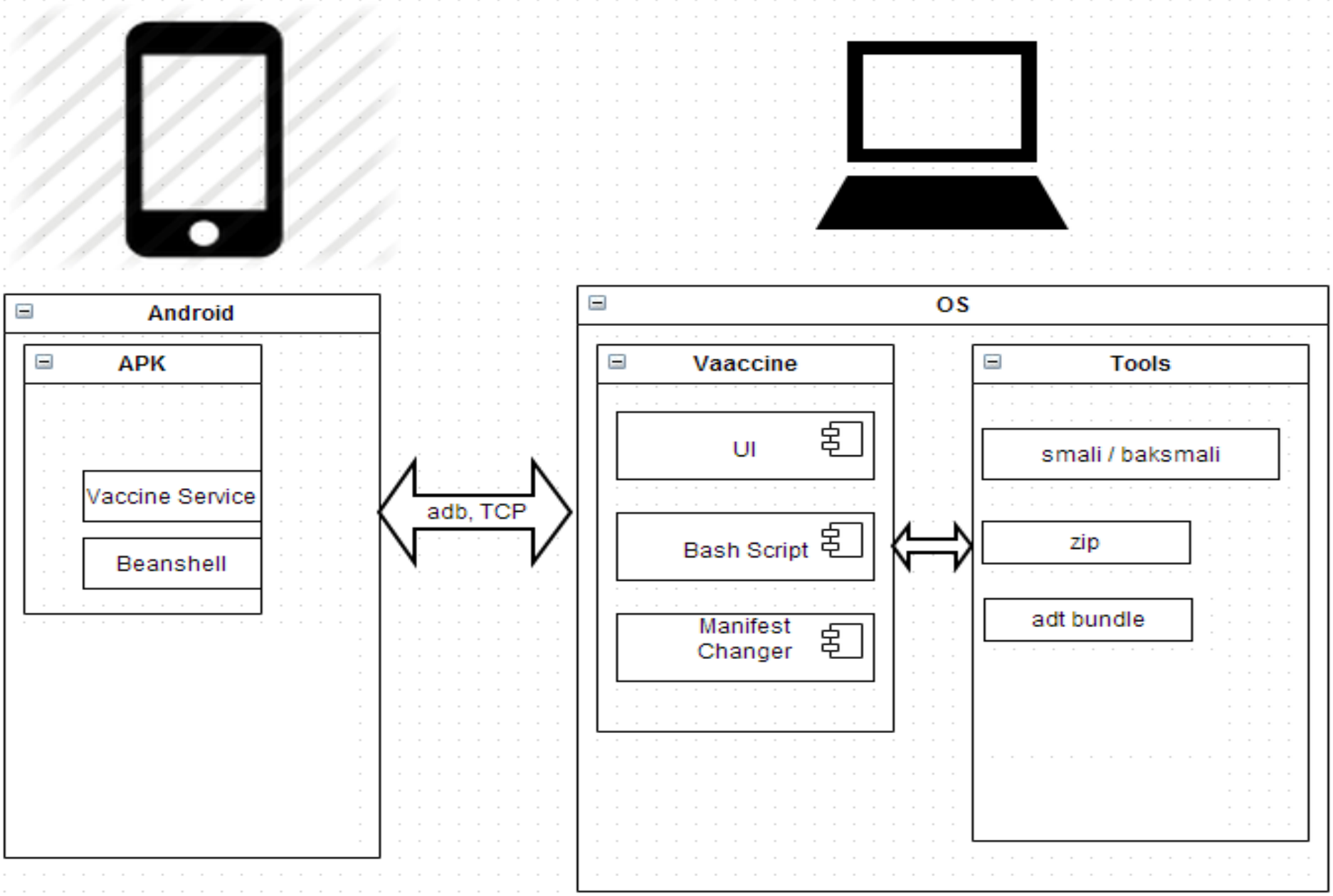
- Authentication PINs in system logs
- Session identifiers and credentials cached in WebView
- Inappropriate data stored in local SQLite databases
- Internal IP’s
- Hardcoded usernames, passwords
- Testing cases left inside code


I WANT MORE!
ENDELMAN
© 2009 David Endelman


DIG
DEEPER

Vaccine

- Repackaging if injecting in APK
- Service injection
- Injecting Beanshell
- Connection and Dynamical analysis


Android
APK
Vaccine Service
Beanshell
adb, TCP
OS
Vaaccine
UI
Bash Script
Manifest Changer
Tools
smali / baksmali
zip
adt bundle

Vaccine (bash)script

> Preparing the APK

- » Copy APK
- » Unzip
- » Baksmali classes.dex – smali source code
- » Adding smali source of service
- » Smaling source – classes.dex
- » Changing AndoidManifest.xml
- » Replacement of classes.dex and AndroidManifest.xml
- » Removing signature
- » Signing
- » Installing the mobile application
- » Starting the service
- » Connecting and showing UI

Vaccine

- Accessing objects and fields
- Executing methods
- Using objects, varibales in java source and beanshell scripts
- ...

Vaccine

- Application
  - class Application Application { }
    - class ArrayList mActivityLifecycleCallbacks { }
    - class ArrayList mAssistCallbacks
    - class ArrayList mComponentCallbacks { }
    - class LoadedApk mLoadedApk { }
      - class String TAG { LoadedApk }
      - class ActivityThread mActivityThread { }
      - class String mAppDir { /data/app/com.jgames.shapegame-1.apl
      - class Application mApplication { }
      - class ApplicationInfo mApplicationInfo { }
      - class ClassLoader mBaseClassLoader

Info | Watch

TAG: LoadedApk

Remove | Set

```
object = object();
object.flag=true;

foo() {
    run() {

        while(object.flag){
                print("Running...");
                Thread.sleep(2000);
            }

    }
    return this;
}

foo = foo();
new Thread( foo ).start();
```

Execute | SHOW METHODS

#/viris[ ]

Demo(s)

```
./vaccine.sh -i android.apk -p 8888
```

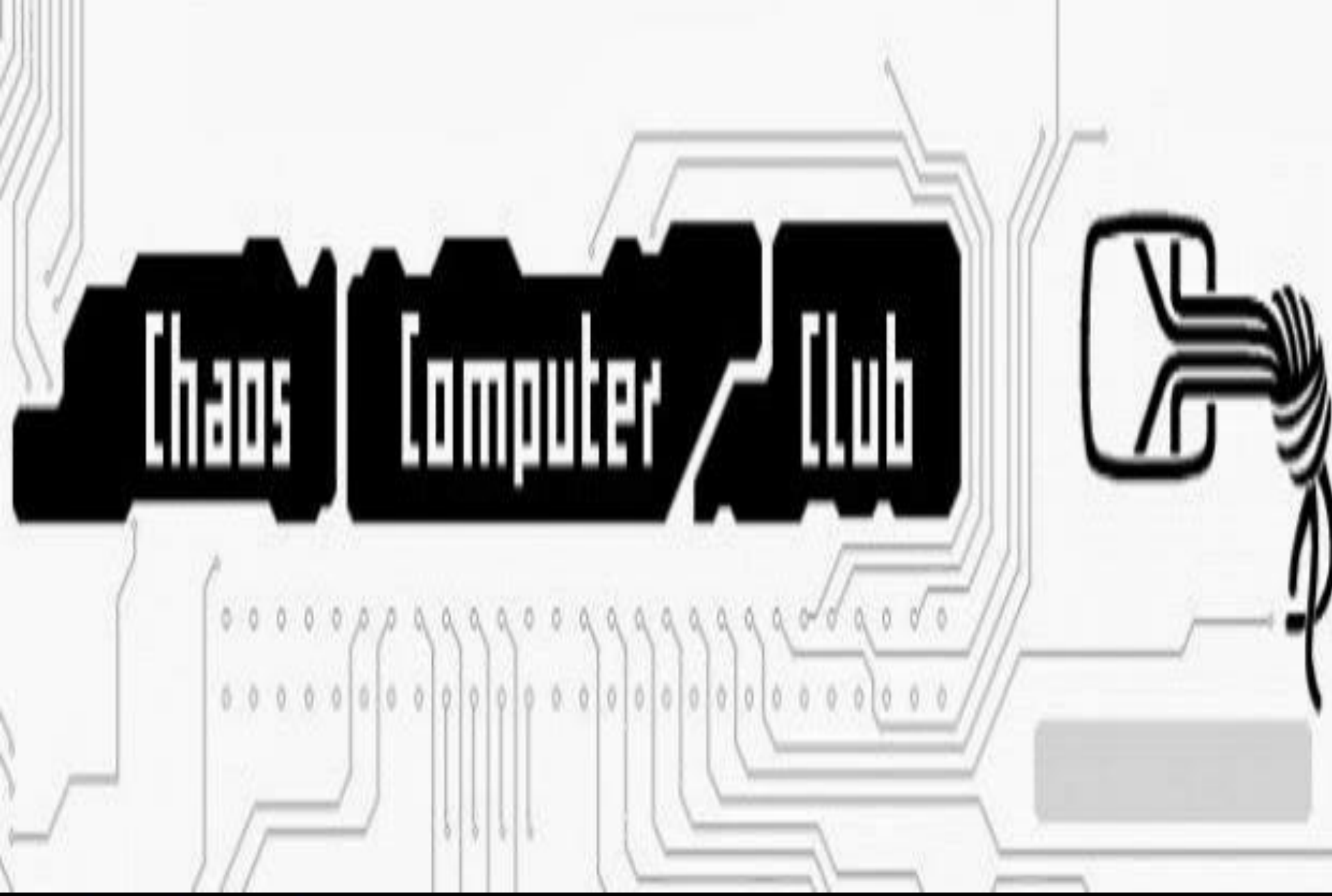
Disclaimer

This presentation was created for educational purposes. We will not take any responsibility for any action you cause using the information shown in this presentation. Please do not contact us with blackhat type hacking requests. Thanks!

Original taken from: http://www.lo0.ro/

Demo(s)

```
./vaccine.sh -i android.apk -p 8888
```


Chaos Computer Club

Northeastern University
Systems Security Lab

Android DDI: Dynamic Dalvik Instrumentation

30th Chaos Communication Congress
Hamburg, Dec. 29th, 2013

Collin Mulliner
collin[at]mulliner.org twitter: @collinrm

Injecting vaccine at runtime

- Little hacking provided Collin's examples
- Instead of changing APK, we "hijack" running process (in our case zygote)
- Inject shared library into process
- Hook android.app.Activity onStart method
- Injects Vaccine service and additional BeanShell classes when app is started
- Use vaccine as before

Demo

> Is it possible to inject Vaccine into Google apps at runtime?

Pros/cons APK Android

- APK
  - No need for rooted phone
  - Untrusted sources
  - Download, modify, upload
- Android
  - No need for APK modification
  - Rooted phone
  - Injecting shared libs (more skills needed)


CHALLENGES
AHEAD
dreamstime.com

Possible usage

- Not only for Android
- Reflection is still NOT dead
- Tested with Oracle Foms
- Have idea to use it with other Java apps/applets (Minecraft maybe)

- **Ultimate cheating platform**

Final thoughts

- One script, small GUI tool (never be finished)
- Help testers, researchers (hackers, cheaters)
- Open for suggestions, improvements, comments


Questions?

www.github.com/viris

@MilanGabor

@alm8i