Unmasking the Godfather

Reverse Engineering the Latest Android Banking Trojan

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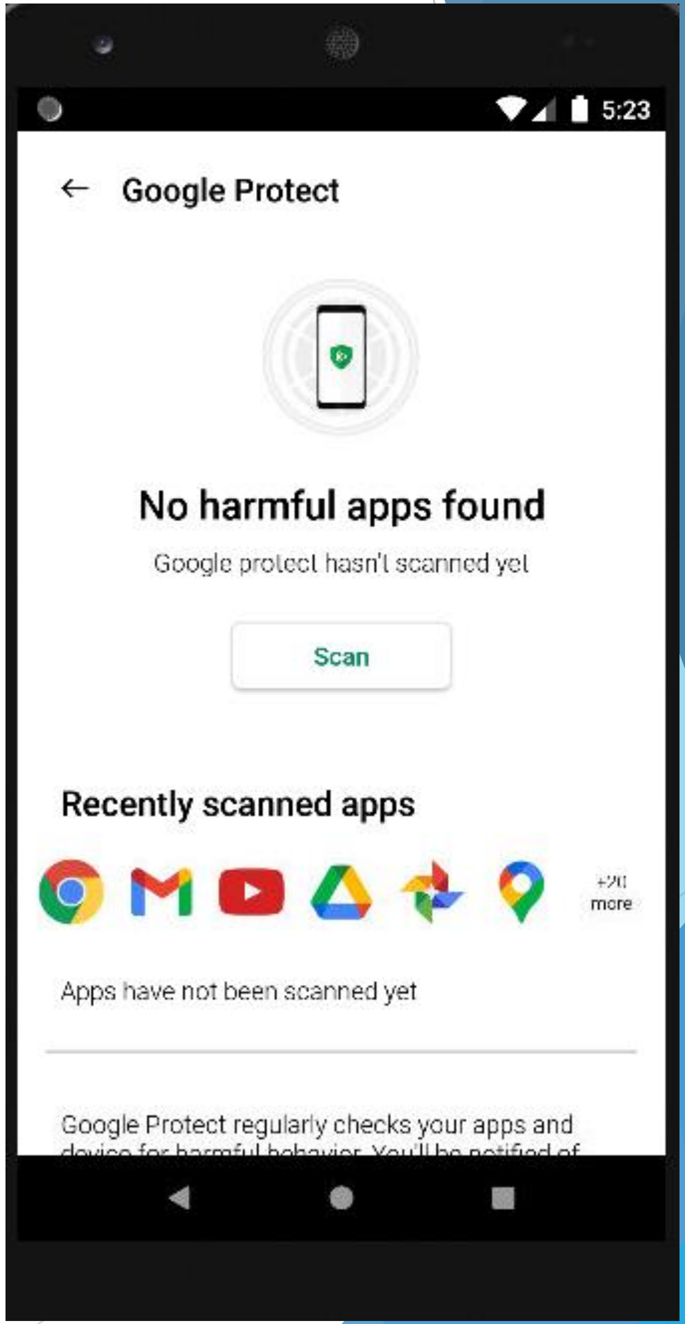
whoami

- Laurie Kirk
- Reverse Engineer at Microsoft
- Specialize in cross-platform malware with a focus on mobile malware
- Run YouTube channel @lauriewired
- Representing myself as an individual security researcher today (not representing Microsoft)

@lauriewired

This application promising to protect you...



No harmful apps found

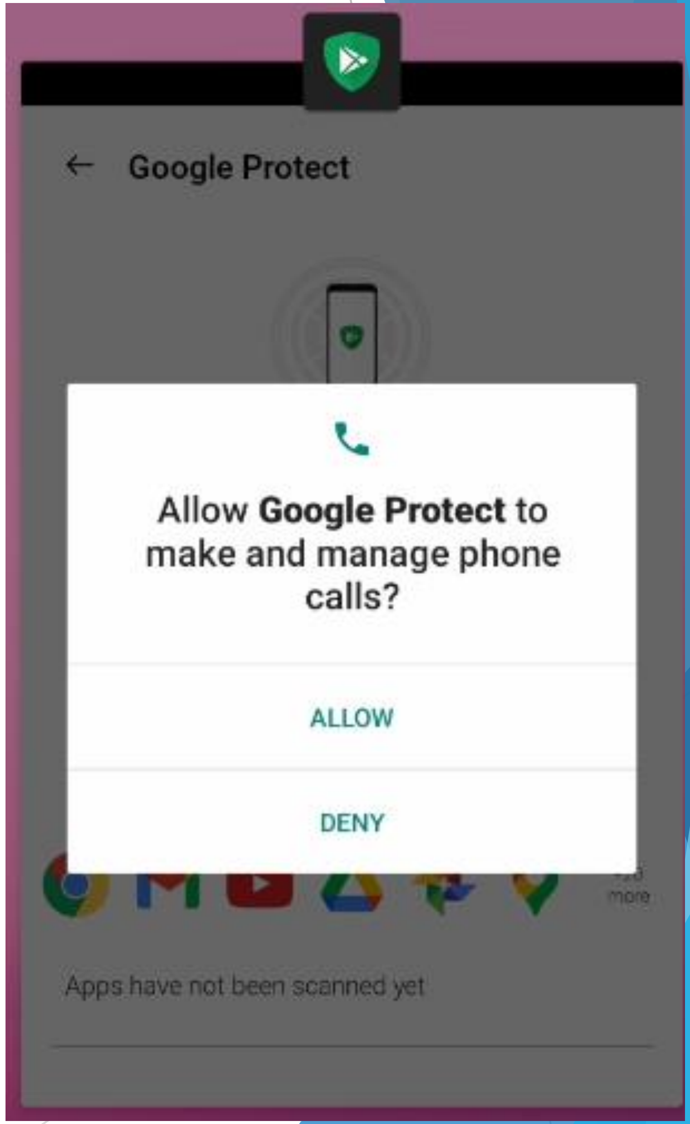
Google protect hasn't scanned yet

Recently scanned apps

Apps have not been scanned yet

Google Protect regularly checks your apps and

is actually going to steal your banking credentials.


Google Protect

Allow **Google Protect** to make and manage phone calls?

Apps have not been scanned yet

The Eternal Struggle Against Banking Trojans

- Plaguing Android users since 2011
- Billions of downloads from Google Play Store
  - Prevalent families: Godfather, Anubis, Cerberus, SharkBot
- Masquerade as legitimate applications

The Origin of The Godfather

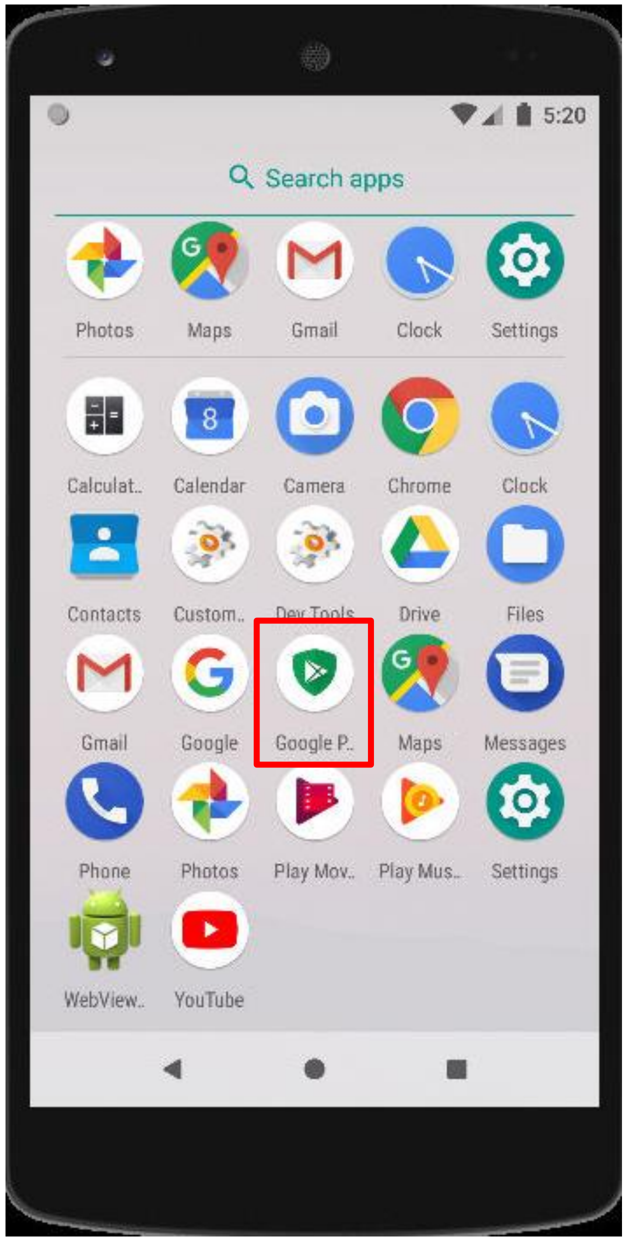
- More than 10 million downloads from Google Play Store
- Targets over 400 financial institutions across 16 countries
- First seen in 2021 and still used today
- Codebase is derived from notorious Anubis malware

If banking trojans have been around so long, why are they still effective?

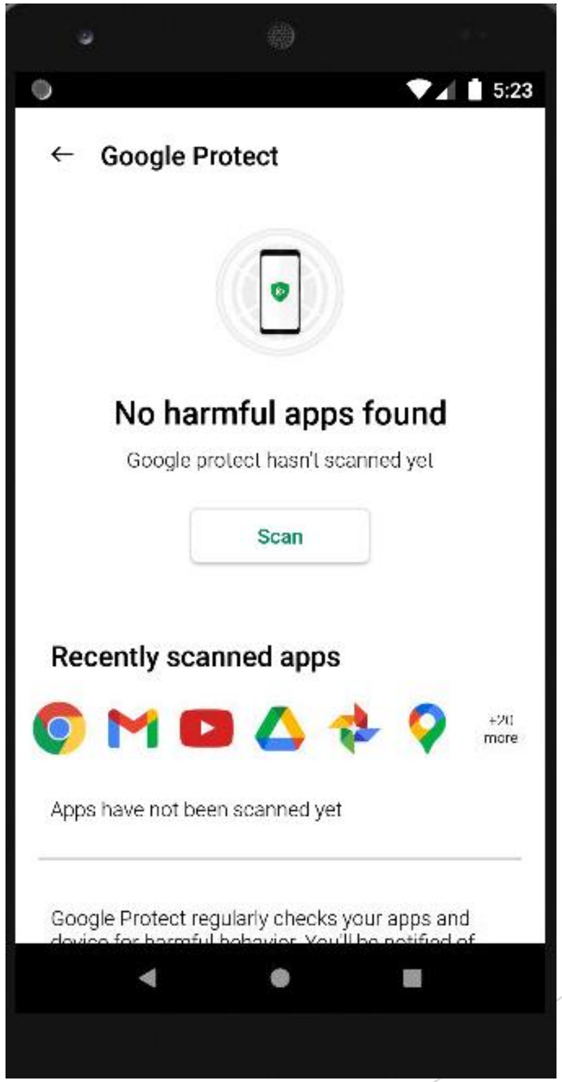
Let’s dive into The Godfather to find out!

Google Protect Icon

- Google Protect is a legitimate application
- Scans device for harmful behavior



Google Protect Activity



No harmful apps found

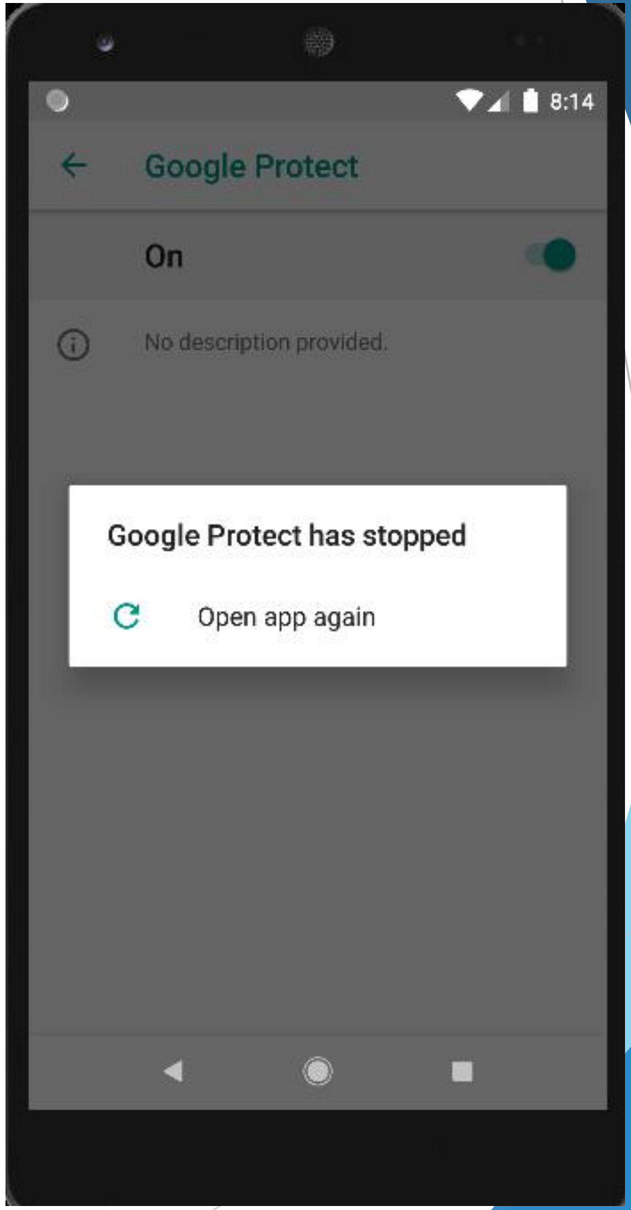
Google protect hasn't scanned yet

Recently scanned apps

Apps have not been scanned yet

Google Protect regularly checks your apps and

Running the app causes a crash


8:14

Google Protect

On

No description provided.

Google Protect has stopped

Open app again

We’re going to have to look at the code.

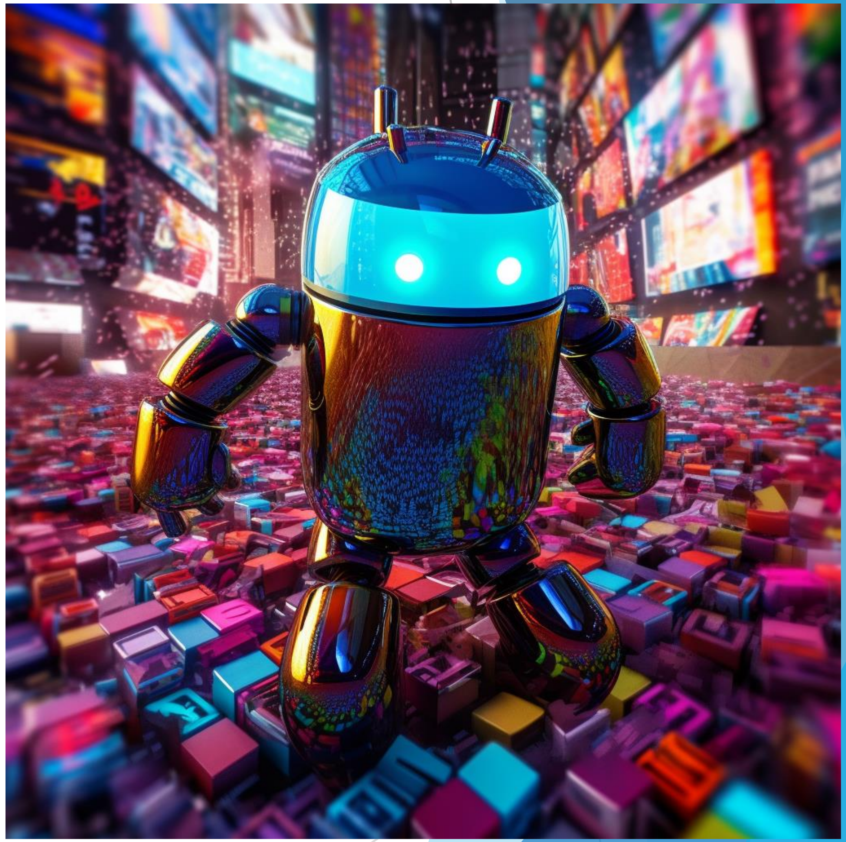
High-Level Application Structure

GoogleProtect.apk

AndroidManifest.xml	classes.dex	assets	lib
<uses-permission	com.thenextbiggeek.squidgamewallpaper	lib.armeabi-v7a.godfat.so	arm64-v8a
<application	net.godfather.thegodfather	lib.armeabi-v7a.vncserver.so	armeabi-v7a
<activity			→libpl_droidsonroids_gif.so
<service			

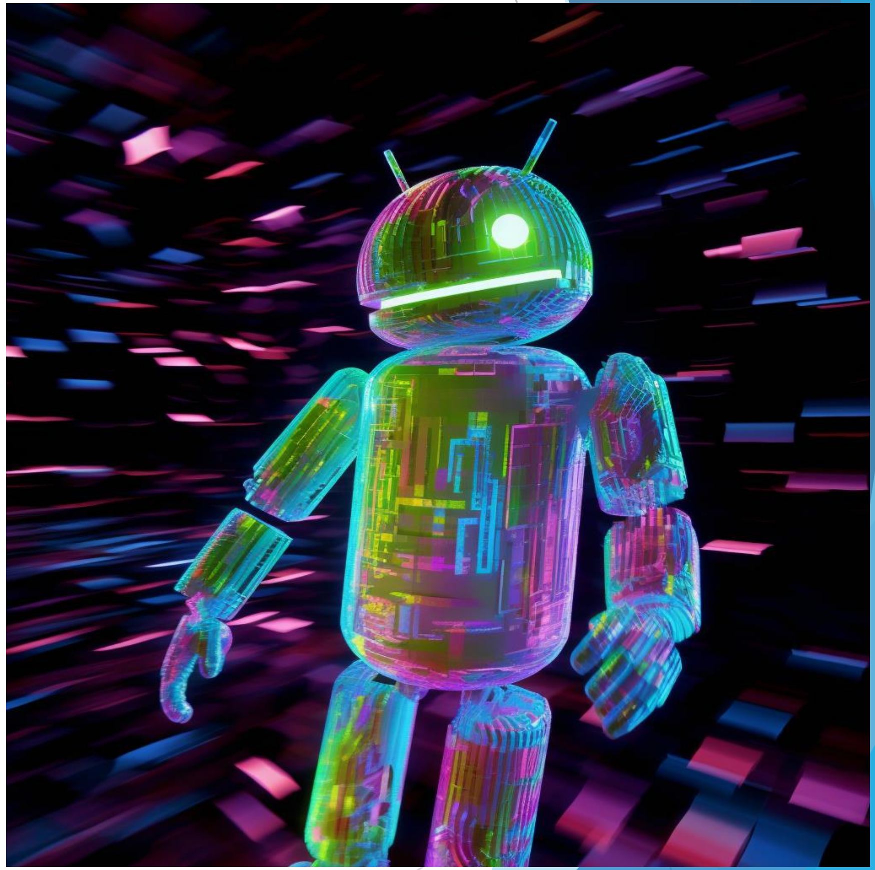
Important Android Components

- Defined in the AndroidManifest.xml
  - Components can run simultaneously in the foreground or background
- Activities
  - User interacts with activities
  - Main foreground components



Android Services and Receivers

- Services
  - Code executes in the background
- Receivers
  - Waits for a certain event to run



Hands On:
Finding the Entrypoint

Why is this code difficult to read?

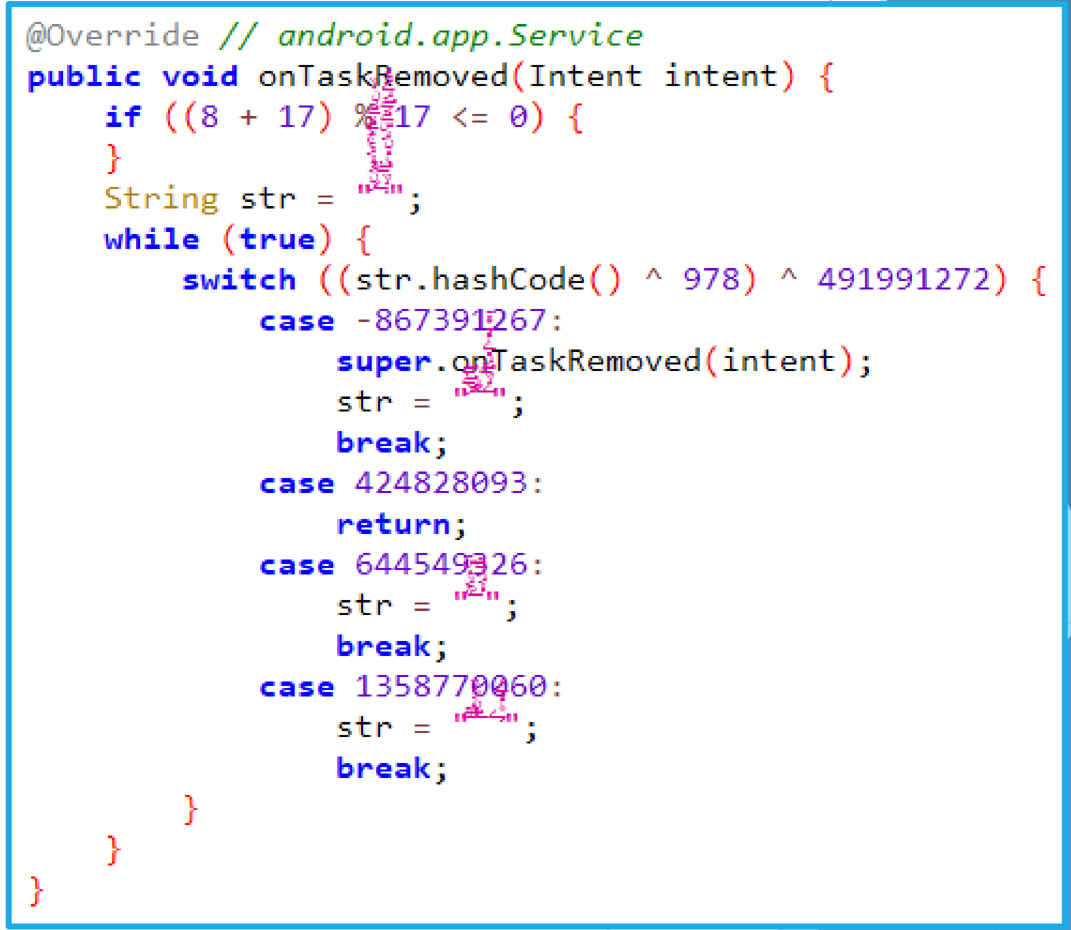
Obfuscation Techniques

First of all, what is obfuscation?

- Obfuscation obscures app data and functionality
- Common among all platforms
- Offensive and defensive motivations for obfuscation
- Essential for Android
  - Decompiled into pretty Java code

Junk Code Insertions

- Uncalled methods
- Pad application with nonsense
- Empty if-statements
- Special character strings



```
@Override // android.app.Service
public void onTaskRemoved(Intent intent) {
    if ((8 + 17) % 17 <= 0) {
    }
    String str = "[illegible]";
    while (true) {
        switch ((str.hashCode() ^ 978) ^ 491991272) {
            case -867391267:
                super.onTaskRemoved(intent);
                str = "[illegible]";
                break;
            case 424828093:
                return;
            case 644549326:
                str = "[illegible]";
                break;
            case 1358770060:
                str = "[illegible]";
                break;
        }
    }
}
```

Hands On:
Decoding Strings

Decoded Strings

Base64 Decoded English Value
Enable accessibility for protection to take effect
System Files Cannot be Removed!
Please activate for updates to be active
device admin app
Phone administrator
Use service
over other apps

Now we’ve found the malicious code, but it’s wrapped in anti-emulation.

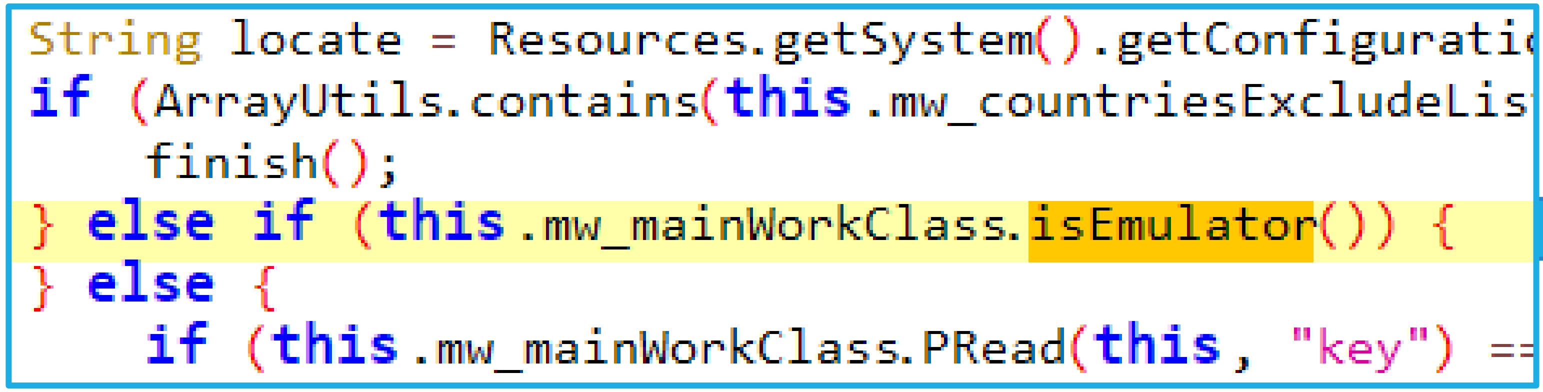
Anti-Emulation

- Avoids executing on Android emulators
  - Prevent reverse engineering
- Heuristic device checks

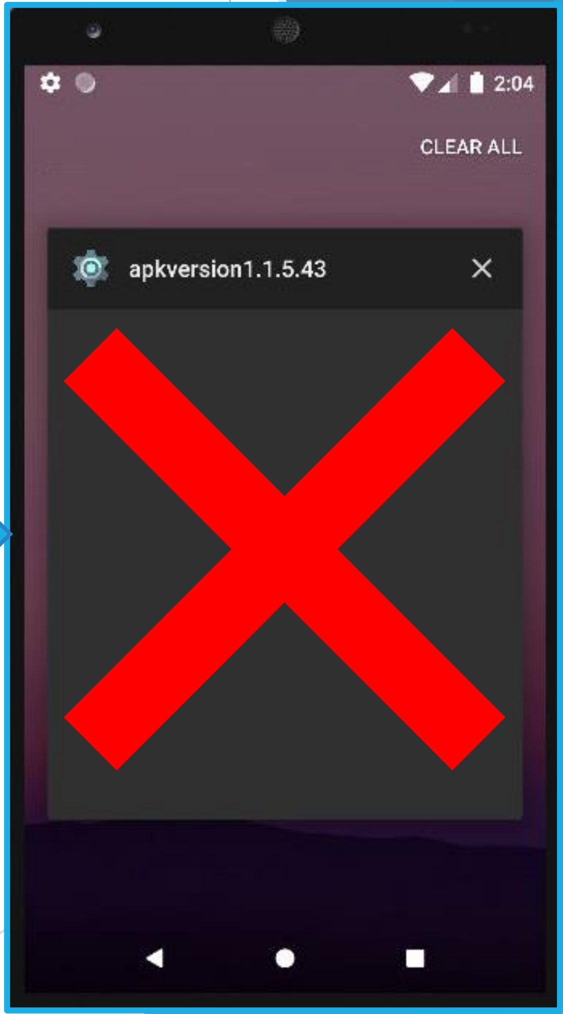
Device Characteristic Checks

Fingerprint	Generic
Model	Emulator, Android SDK built for x86
Brand	generic_x86
Device	vbox86p
Manufacturer	Genymotion, unkown
Hardware	Goldfish

If isEmulator returns true, the device hangs



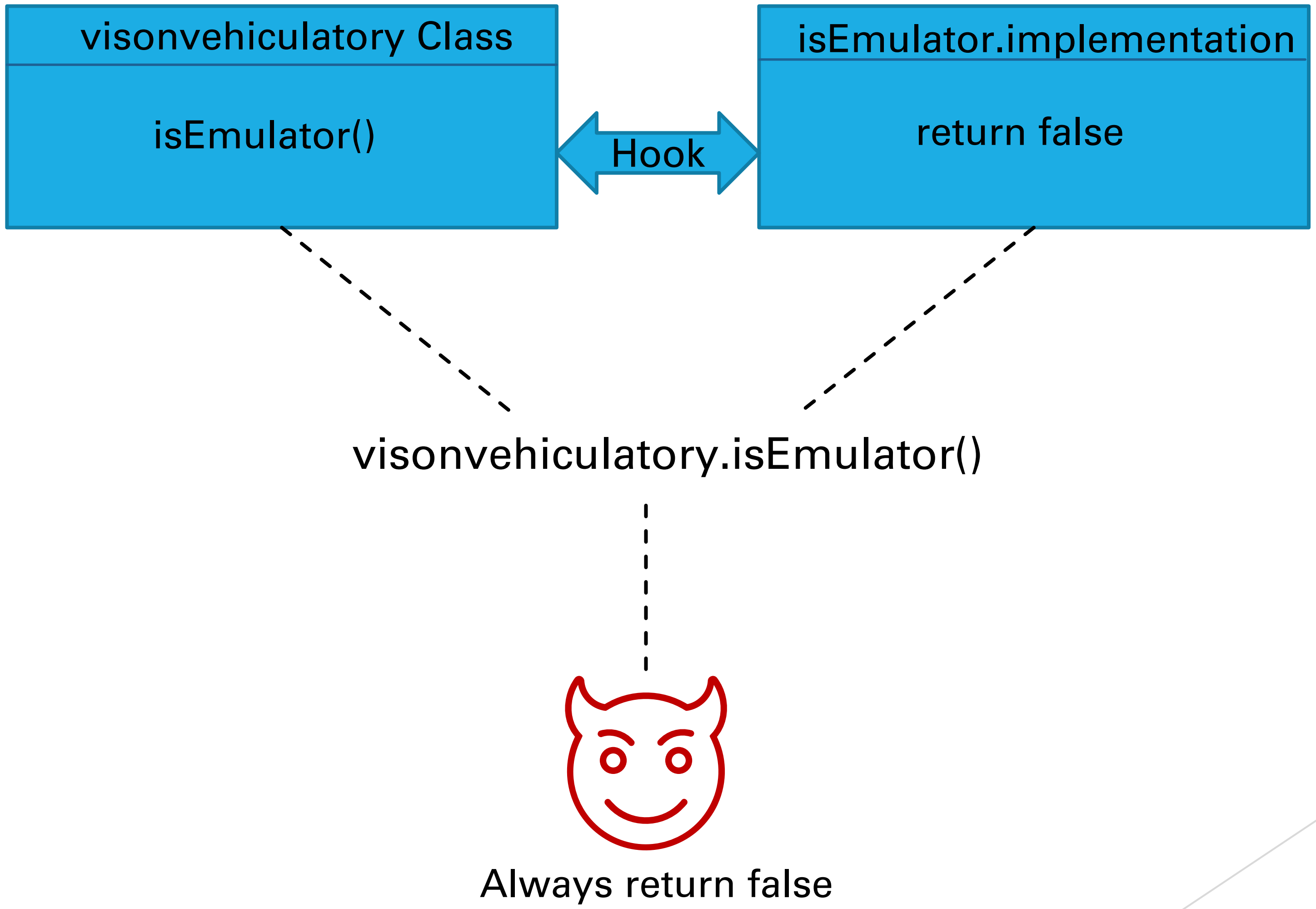
```
String locate = Resources.getSystem().getConfigurati
if (ArrayUtils.contains(this.mw_countriesExcludeLis
    finish();
} else if (this.mw_mainWorkClass.isEmulator()) {
} else {
    if (this.mw_mainWorkClass.PRead(this, "key") ==
```



Defeating Anti-Emulation with Hooking

- Frida is a multi-platform code instrumentation toolkit
- Write new method functionality during runtime

Defeating Anti-Emulation with Frida



Hands On:
Using Frida to Defeat Anti-Emulation

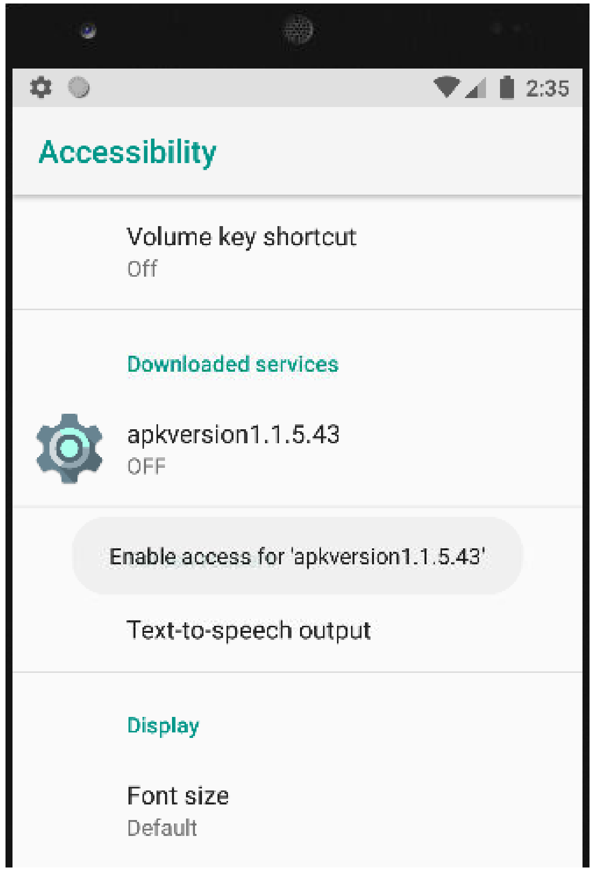
Or you could just run an ARM emulator… lol

Why did they keep spamming accessibility requests though?

Accessibility Features

- Legitimate Android feature
    - Provides additional functionality for vision, audio, and mobility needs
- Allows an app to perform extra device manipulation
- Does not require user approval

All Godfather Variants Spam Accessibility


2:35

Accessibility

Volume key shortcut
Off

Downloaded services

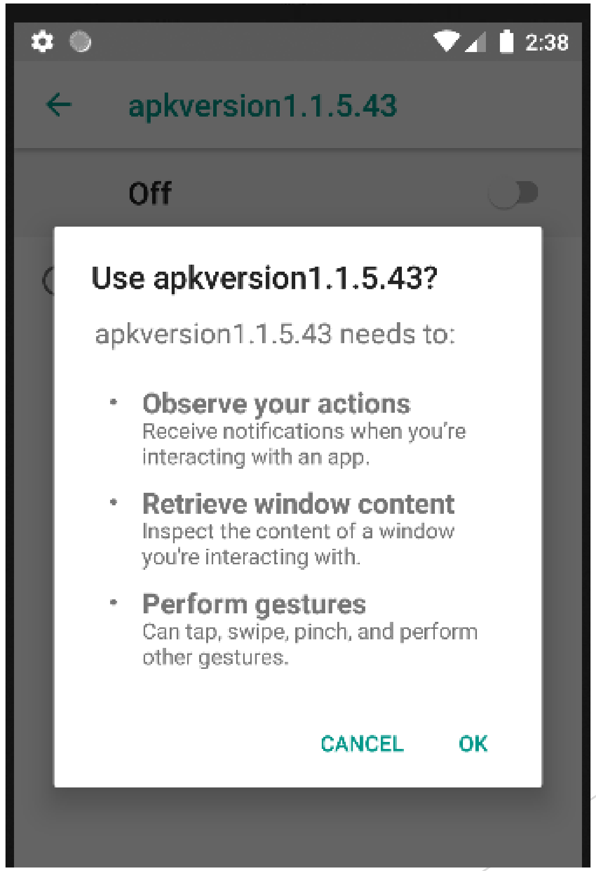
apkversion1.1.5.43
OFF

Enable access for 'apkversion1.1.5.43'

Text-to-speech output

Display

Font size
Default


2:38

apkversion1.1.5.43

Off

Use apkversion1.1.5.43?

apkversion1.1.5.43 needs to:

- **Observe your actions**
  Receive notifications when you're interacting with an app.
- **Retrieve window content**
  Inspect the content of a window you're interacting with.
- **Perform gestures**
  Can tap, swipe, pinch, and perform other gestures.

CANCEL OK

ENABLES ACCESSIBILITY TO
SHUT OFF THE ANNOYING NOTIFICATIONS.
BANK ACCOUNT NOW SHOWING NEGATIVE

Summary of Accessibility Attempts

- Shared among all Godfather variants
- Repeated popup in the center of the screen
- Alarm triggered until accessibility enabled
- Constantly brings user back to settings page

They really want us to enable accessibility settings.

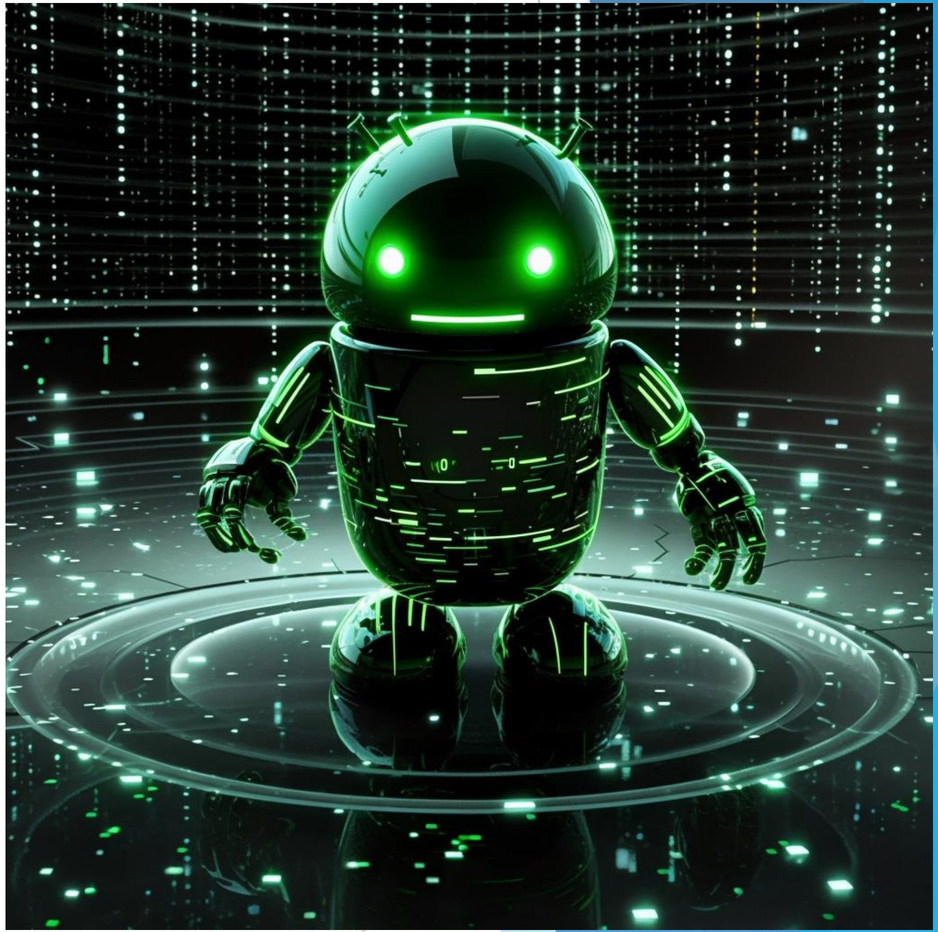
We need to keep digging into the code to find out why.

Hands On:
Analyzing the “Godfather” Module

Hands On:
Seeing the Native Code References

Android Native Code

- Native code in Android is C/C++ code
- Compiled to run on a particular instruction set architecture
  - x86, ARM, ARM64
- Shared object (.so) binaries

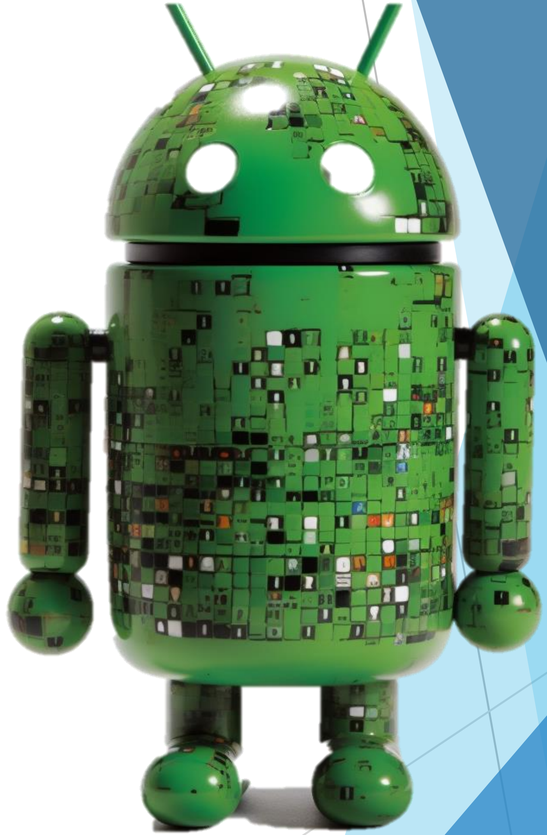


Godfather DecryptAsset Class

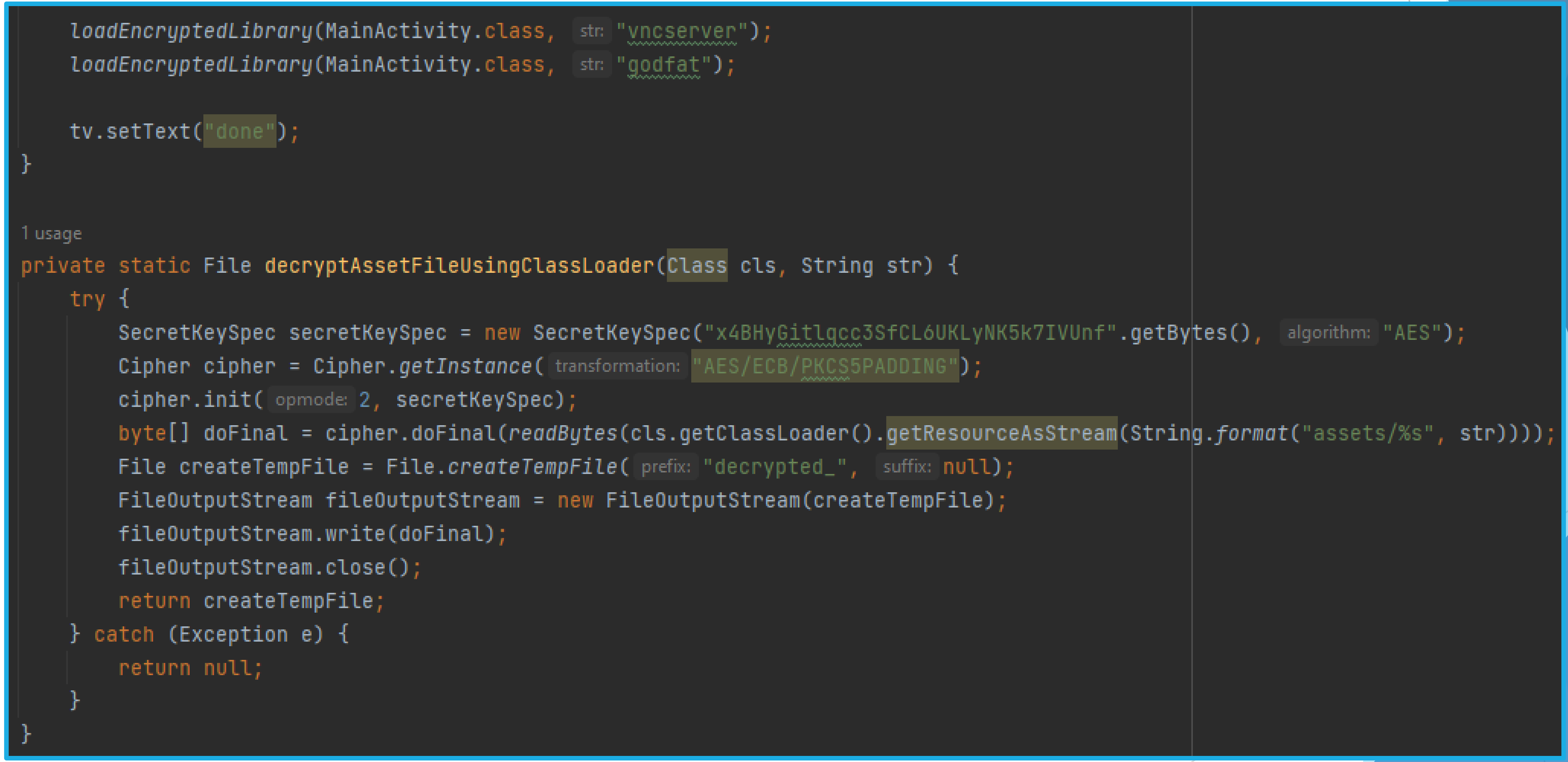
- AES decrypt binary
- Create temp file
- Load native binary

Writing a Custom Decryptor

- Create custom app and paste decryptor code
- Feed in asset file and write to disk
- Use the Android Debug Bridge (ADB) to pull the decrypted files

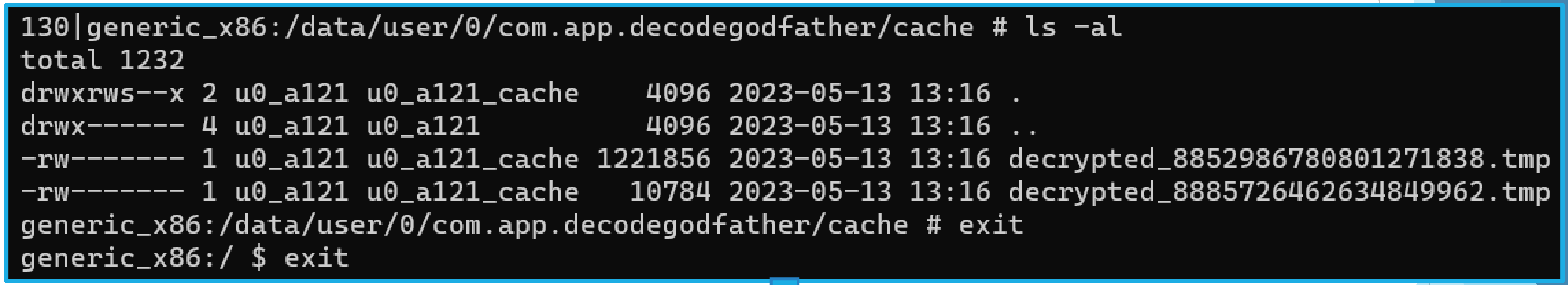


Stealing Partial Decryption Code

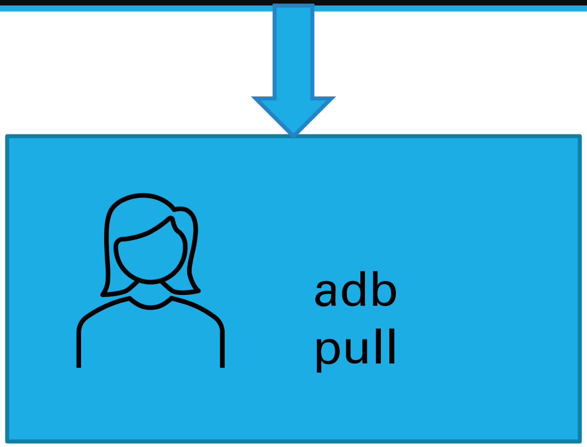


```java
    loadEncryptedLibrary(MainActivity.class, str: "vncserver");
    loadEncryptedLibrary(MainActivity.class, str: "godfat");

    tv.setText("done");
}

1 usage
private static File decryptAssetFileUsingClassLoader(Class cls, String str) {
    try {
        SecretKeySpec secretKeySpec = new SecretKeySpec("x4BHyGitlqcc3SfCL6UKLyNK5k7IVUnf".getBytes(), algorithm: "AES");
        Cipher cipher = Cipher.getInstance( transformation: "AES/ECB/PKCS5PADDING");
        cipher.init( opmode: 2, secretKeySpec);
        byte[] doFinal = cipher.doFinal(readBytes(cls.getClassLoader().getResourceAsStream(String.format("assets/%s", str))));
        File createTempFile = File.createTempFile( prefix: "decrypted_", suffix: null);
        FileOutputStream fileOutputStream = new FileOutputStream(createTempFile);
        fileOutputStream.write(doFinal);
        fileOutputStream.close();
        return createTempFile;
    } catch (Exception e) {
        return null;
    }
}
```

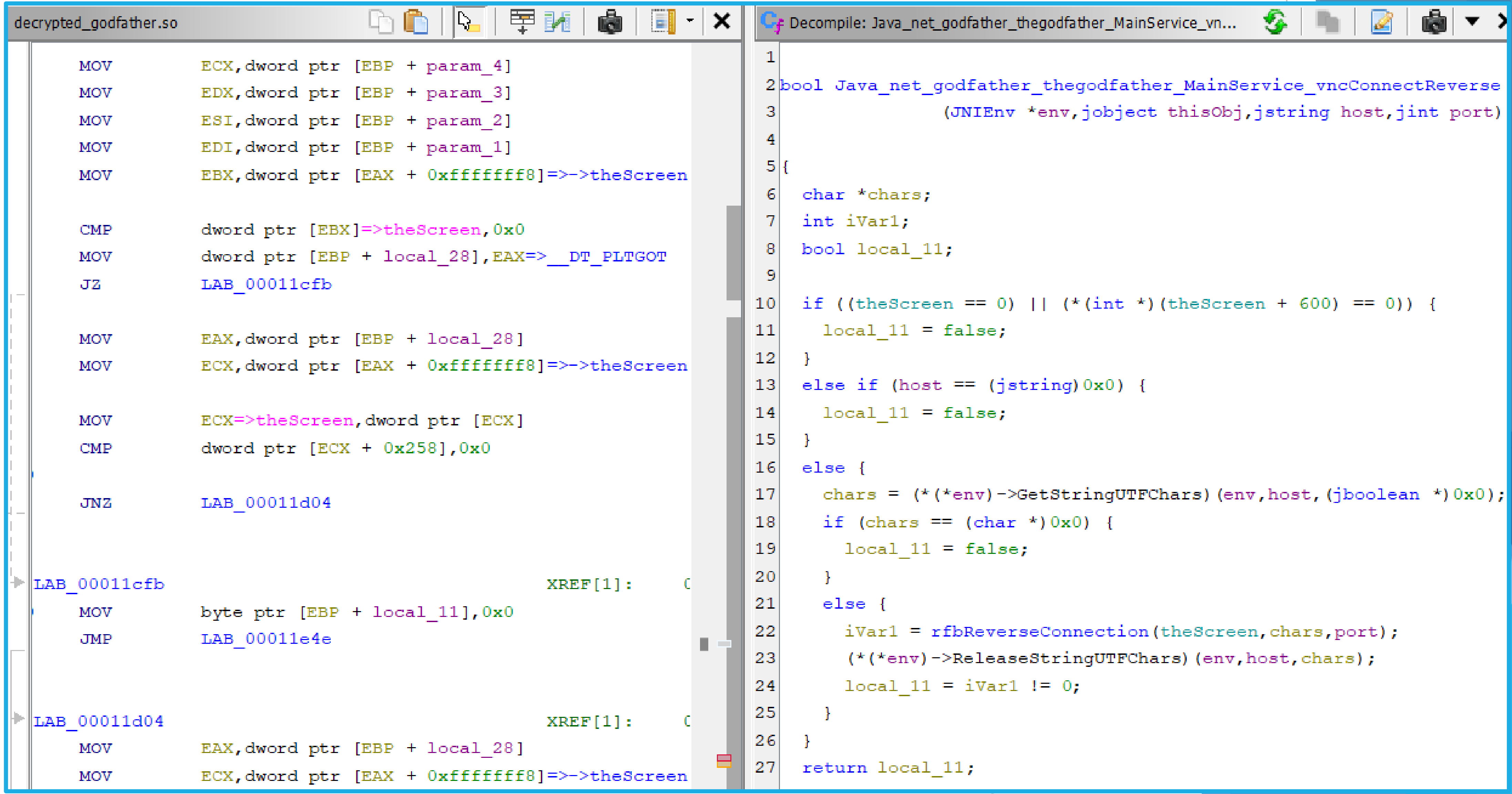
Pulling Files from the Device



```
130|generic_x86:/data/user/0/com.app.decodegodfather/cache # ls -al
total 1232
drwxrws--x 2 u0_a121 u0_a121_cache    4096 2023-05-13 13:16 .
drwx------ 4 u0_a121 u0_a121          4096 2023-05-13 13:16 ..
-rw------- 1 u0_a121 u0_a121_cache 1221856 2023-05-13 13:16 decrypted_8852986780801271838.tmp
-rw------- 1 u0_a121 u0_a121_cache   10784 2023-05-13 13:16 decrypted_8885726462634849962.tmp
generic_x86:/data/user/0/com.app.decodegodfather/cache # exit
generic_x86:/ $ exit
```



Decrypted Native Code in Ghidra



decrypted_godfather.so

```
        MOV        ECX,dword ptr [EBP + param_4]
        MOV        EDX,dword ptr [EBP + param_3]
        MOV        ESI,dword ptr [EBP + param_2]
        MOV        EDI,dword ptr [EBP + param_1]
        MOV        EBX,dword ptr [EAX + 0xfffffff8]=>->theScreen

        CMP        dword ptr [EBX]=>theScreen,0x0
        MOV        dword ptr [EBP + local_28],EAX=>__DT_PLTGOT
        JZ         LAB_00011cfb

        MOV        EAX,dword ptr [EBP + local_28]
        MOV        ECX,dword ptr [EAX + 0xfffffff8]=>->theScreen

        MOV        ECX=>theScreen,dword ptr [ECX]
        CMP        dword ptr [ECX + 0x258],0x0

        JNZ        LAB_00011d04


LAB_00011cfb                                XREF[1]:     0
        MOV        byte ptr [EBP + local_11],0x0
        JMP        LAB_00011e4e


LAB_00011d04                                XREF[1]:     0
        MOV        EAX,dword ptr [EBP + local_28]
        MOV        ECX,dword ptr [EAX + 0xfffffff8]=>->theScreen
```

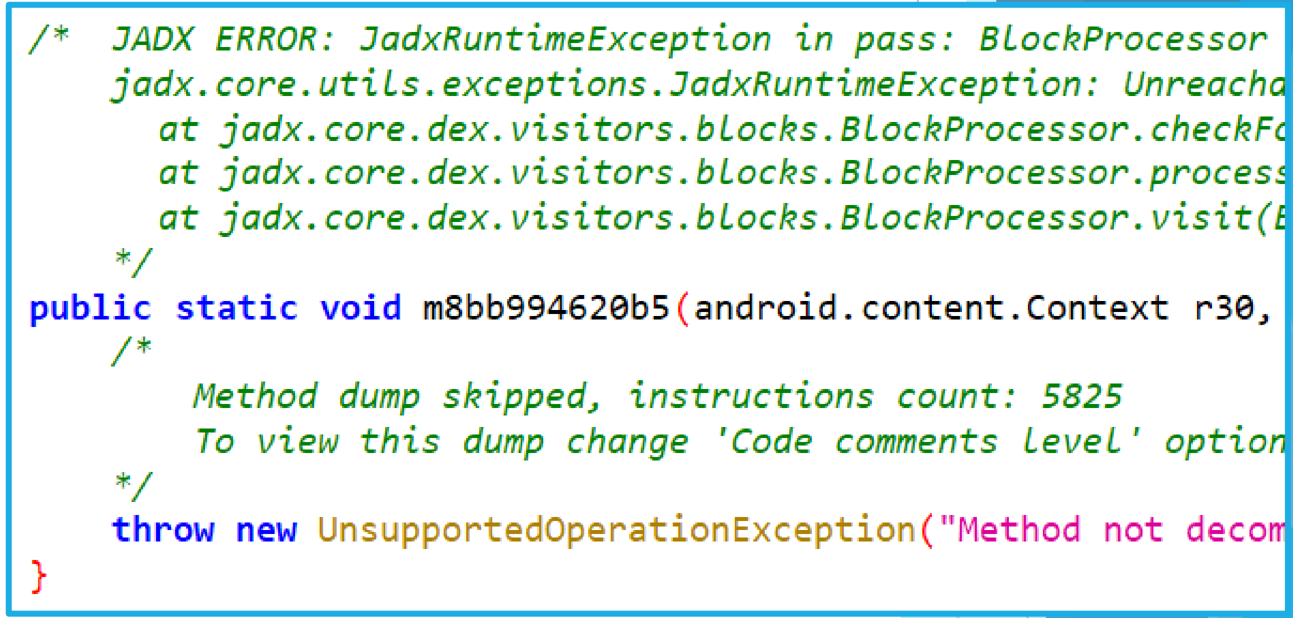
Decompile: Java_net_godfather_thegodfather_MainService_vn...

```

bool Java_net_godfather_thegodfather_MainService_vncConnectReverse
               (JNIEnv *env,jobject thisObj,jstring host,jint port)

{
  char *chars;
  int iVar1;
  bool local_11;

  if ((theScreen == 0) || (*(int *)(theScreen + 600) == 0)) {
    local_11 = false;
  }
  else if (host == (jstring)0x0) {
    local_11 = false;
  }
  else {
    chars = (*(*env)->GetStringUTFChars)(env,host,(jboolean *)0x0);
    if (chars == (char *)0x0) {
      local_11 = false;
    }
    else {
      iVar1 = rfbReverseConnection(theScreen,chars,port);
      (*(*env)->ReleaseStringUTFChars)(env,host,chars);
      local_11 = iVar1 != 0;
    }
  }
  return local_11;
```

I followed the rabbit trail to analyze the native code, but it does exactly what it claims.

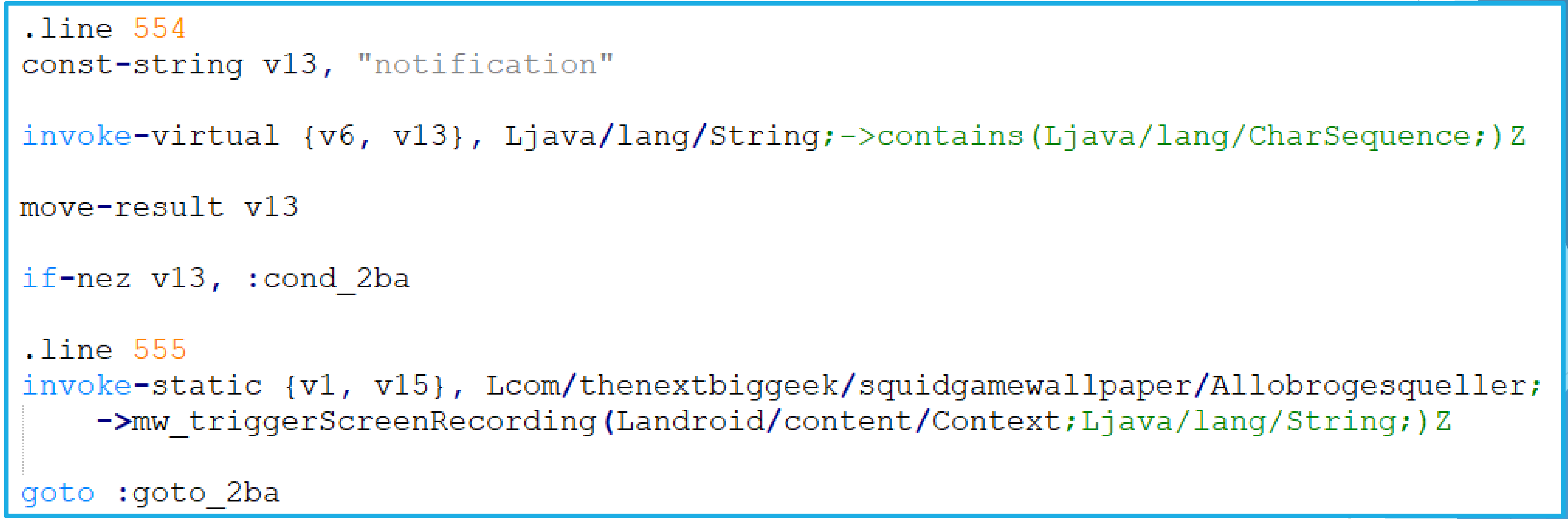
Godfather Anti-Decompilation

- Thwart decompilation of Java code
  - Insert additional bytes
  - Create unreachable code blocks
- Can be intentional or accidental obfuscation



```
/*  JADX ERROR: JadxRuntimeException in pass: BlockProcessor
    jadx.core.utils.exceptions.JadxRuntimeException: Unreacha
      at jadx.core.dex.visitors.blocks.BlockProcessor.checkFo
      at jadx.core.dex.visitors.blocks.BlockProcessor.process
      at jadx.core.dex.visitors.blocks.BlockProcessor.visit(B
    */
public static void m8bb994620b5(android.content.Context r30,
    /*
        Method dump skipped, instructions count: 5825
        To view this dump change 'Code comments level' option
    */
    throw new UnsupportedOperationException("Method not decom
}
```

No one wants to read smali…
(unless they have to)



```
.line 554
const-string v13, "notification"

invoke-virtual {v6, v13}, Ljava/lang/String;->contains(Ljava/lang/CharSequence;)Z

move-result v13

if-nez v13, :cond_2ba

.line 555
invoke-static {v1, v15}, Lcom/thenextbiggeek/squidgamewallpaper/Allobrogesqueller;
    ->mw_triggerScreenRecording(Landroid/content/Context;Ljava/lang/String;)Z

goto :goto_2ba
```

Time to try another decompiler.
Thanks Recaf!

We finally know why they were so pushy about accessibility!

HTML Phishing Pages

Check foreground application

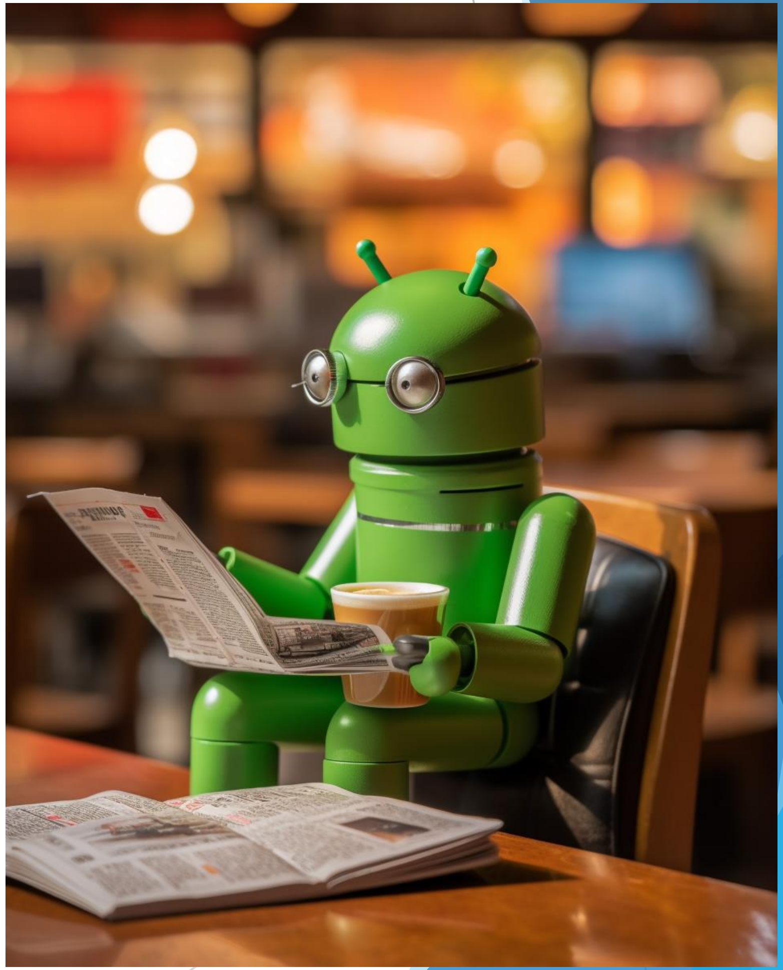
Create new WebView client class

Load HTML from malicious URL

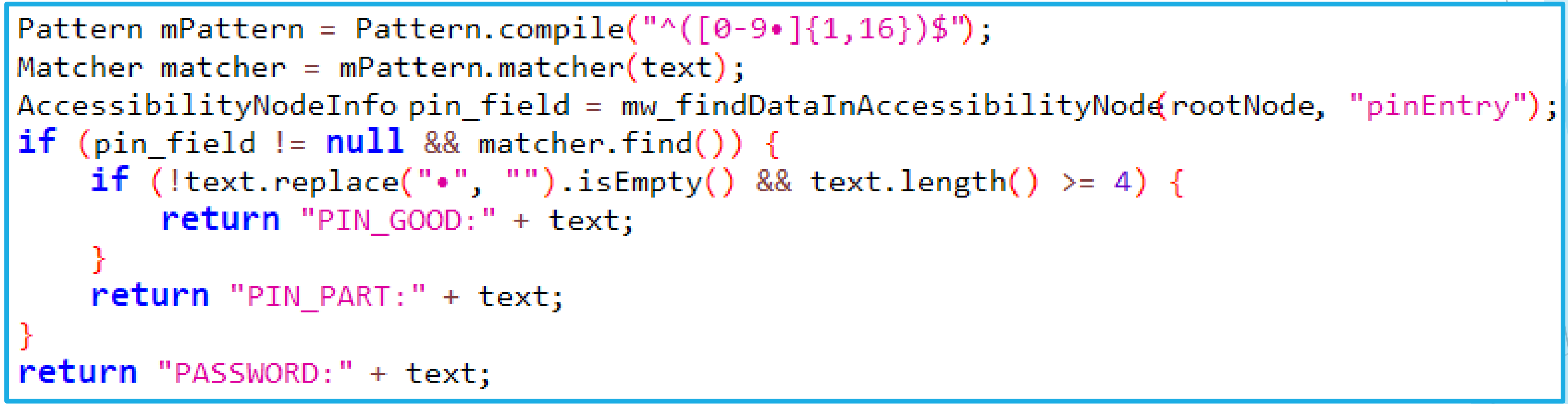
Overlay fake webpage on top of legitimate app

Victims Enter Sensitive Data into Fake Pages

- Abuse accessibility to capture screen data
- Use regular expressions to search for patterns of interest
  - Pins, passwords



Parsing Pins with Regular Expressions



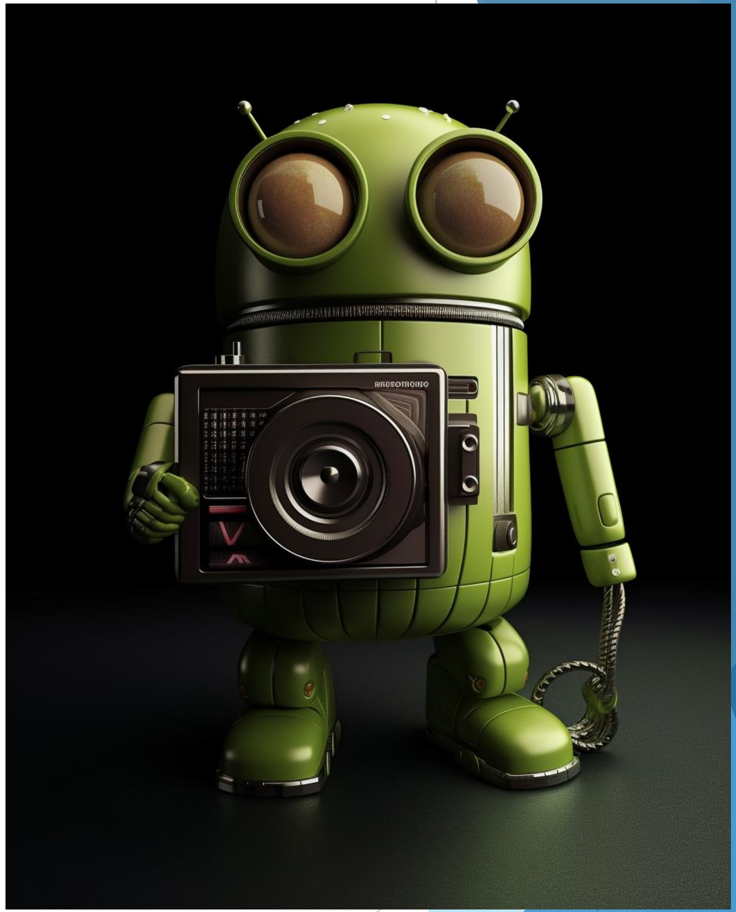
```java
Pattern mPattern = Pattern.compile("^([0-9•]{1,16})$");
Matcher matcher = mPattern.matcher(text);
AccessibilityNodeInfo pin_field = mw_findDataInAccessibilityNode(rootNode, "pinEntry");
if (pin_field != null && matcher.find()) {
    if (!text.replace("•", "").isEmpty() && text.length() >= 4) {
        return "PIN_GOOD:" + text;
    }
    return "PIN_PART:" + text;
}
return "PASSWORD:" + text;
```

Posting Data to URL

- Gathers device data and recorded malicious events
- Stores encrypted command and control server
- Base64 encodes event data
  - POSTs data to the C2 server

Screen Recording

- Records screen data
  - Using built-in Android MediaRecorder class
- Saves to MP4 file
- Uploads file to C2 server



Full Godfather Commands and Capabilities

Command String	Action
startUSSD	Call phone (USSD)
startApp	Start specified app on the device
startforward	Forward calls on the device
openbrowser	Open specified URL in default browser
killbot	Open the settings for the current app
startPush	Start the WebView activity with a malicious URL
startsocks5	Open socket connection
open (array)	VNC session, keylogger, video recorder, screen locker

Summarize Our Findings

Obfuscation Used by the Godfather

- Meaningless identifiers
- String / class encryption
- Junk code insertions
- Anti-emulation checks
- Native code

Config with SharedPreferences

- Hides strings by using a key-value pair to hold the config
- Allows custom behavior per infected device
  - Stores malicious URL, whether accessibility enabled, keylogger active
  - Allows device characteristic checking during runtime

Avoids Execution for Certain Countries

Code	Country
RU	Russia
AZ	Azerbaijan
AM	Armenia
BY	Belarus
KZ	Kazakhstan
KG	Kyrgyzstan
MD	Moldova
UZ	Uzbekistan
TJ	Tajikistan

Components

Services

- Runs malicious Godfather service
- Receives remote commands

Receivers

- Awaits notification of Accessibility permissions granted

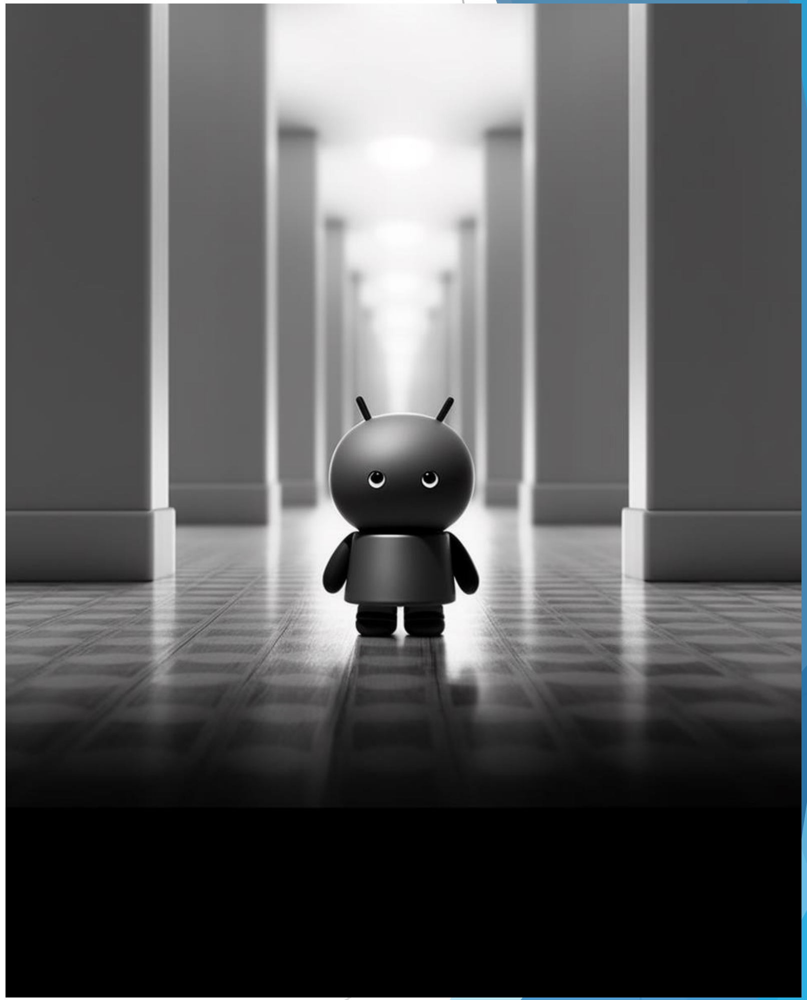
Activities

- Trojanized Google Protect interface
- Fake WebView pages

Android Banking Trojans In the Wild

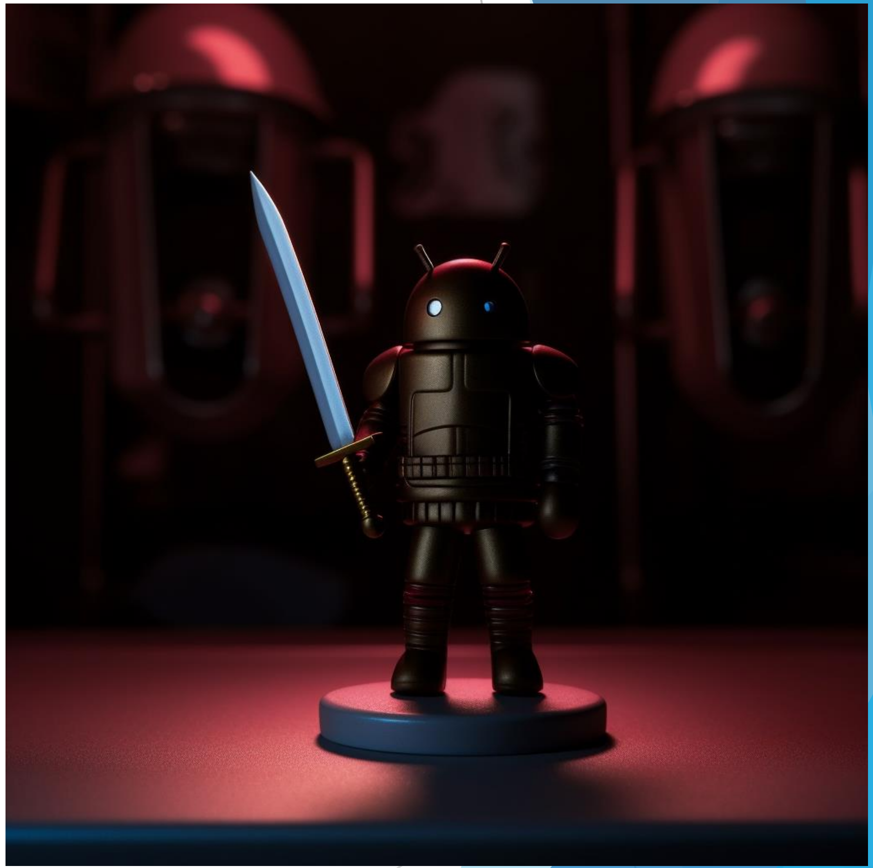
Targets

- Financial applications
- Authenticators and OTP generators
- Cryptocurrency apps

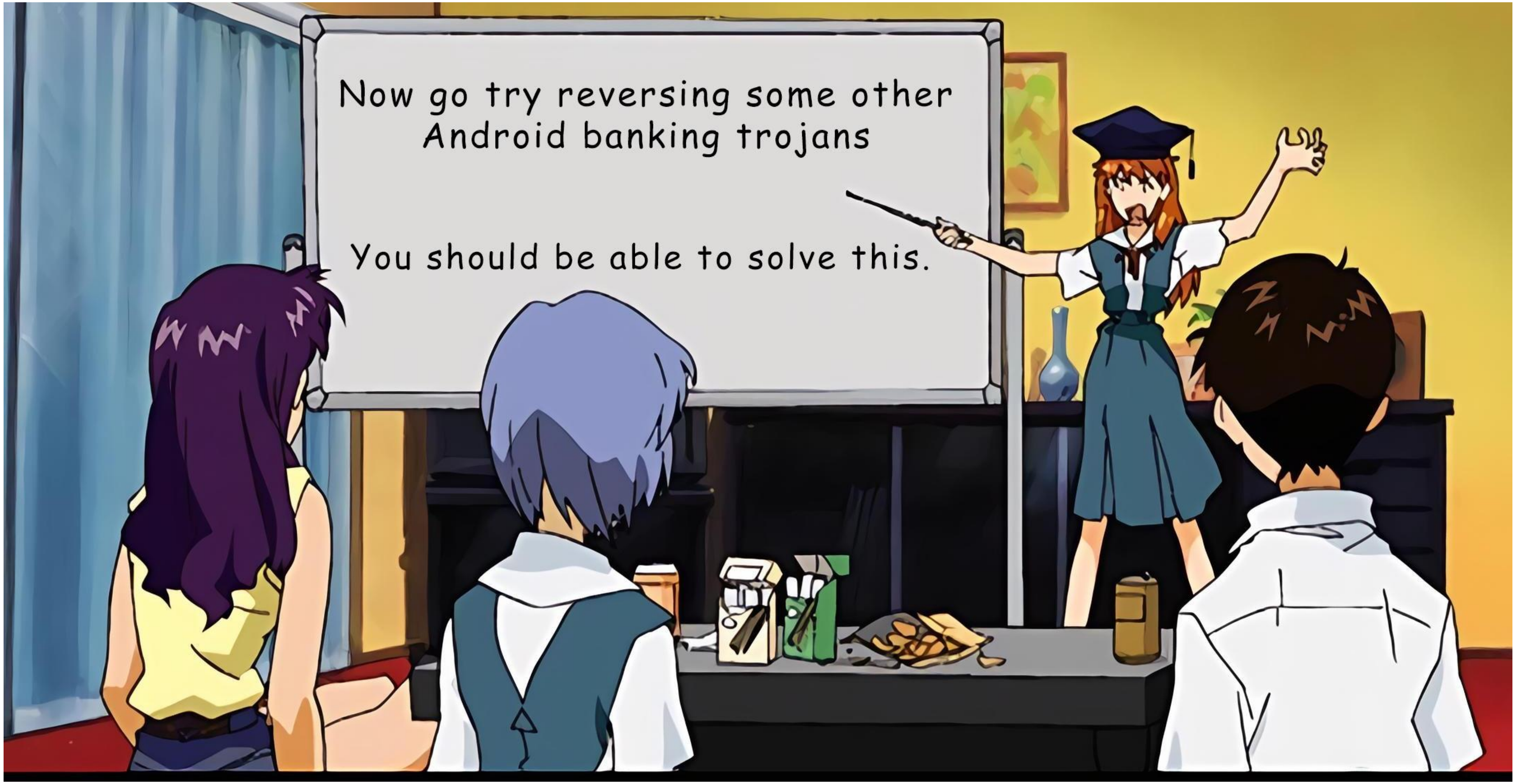


Common Capabilities

- Abuse accessibility services
- Create fake HTML overlays to steal credentials
- Spy on infected device screens and SMS messages
- Perform commands from command-and-control (C2) server
- Intercept 2FA one-time-passwords (OTPs)



That seems familiar. Didn’t we already reverse engineer that?


Now go try reversing some other Android banking trojans
You should be able to solve this.

Thank you!

Bonus Section

Godfather IOCs

- 0b72c22517fdefd4cf0466d8d4c634ca73b7667d378be688efe131af4ac3aed8
- A14aad1265eb307fbe71a3a5f6e688408ce153ff19838b3c5229f26ee3ece5dd
- Marked up JADX file
  - LaurieWired Godfather repository: https://github.com/LaurieWired

Other Banker IOCs

- Cerberus
  - https://bazaar.abuse.ch/sample/c81234b6ceb3572c6d862a9313e019b98efd83165d8c085bd3e74971c66763bb/
- Anubis
  - https://bazaar.abuse.ch/sample/731c0da8d74adbb557a0abd4ec2aa6c61e09d429560d76549881f08e564b27cd/
- Sharkbot
  - https://bazaar.abuse.ch/sample/71c78101f7792fe879a082e323fed89c5e4a43132d01d3f79ed02afd8db45497/

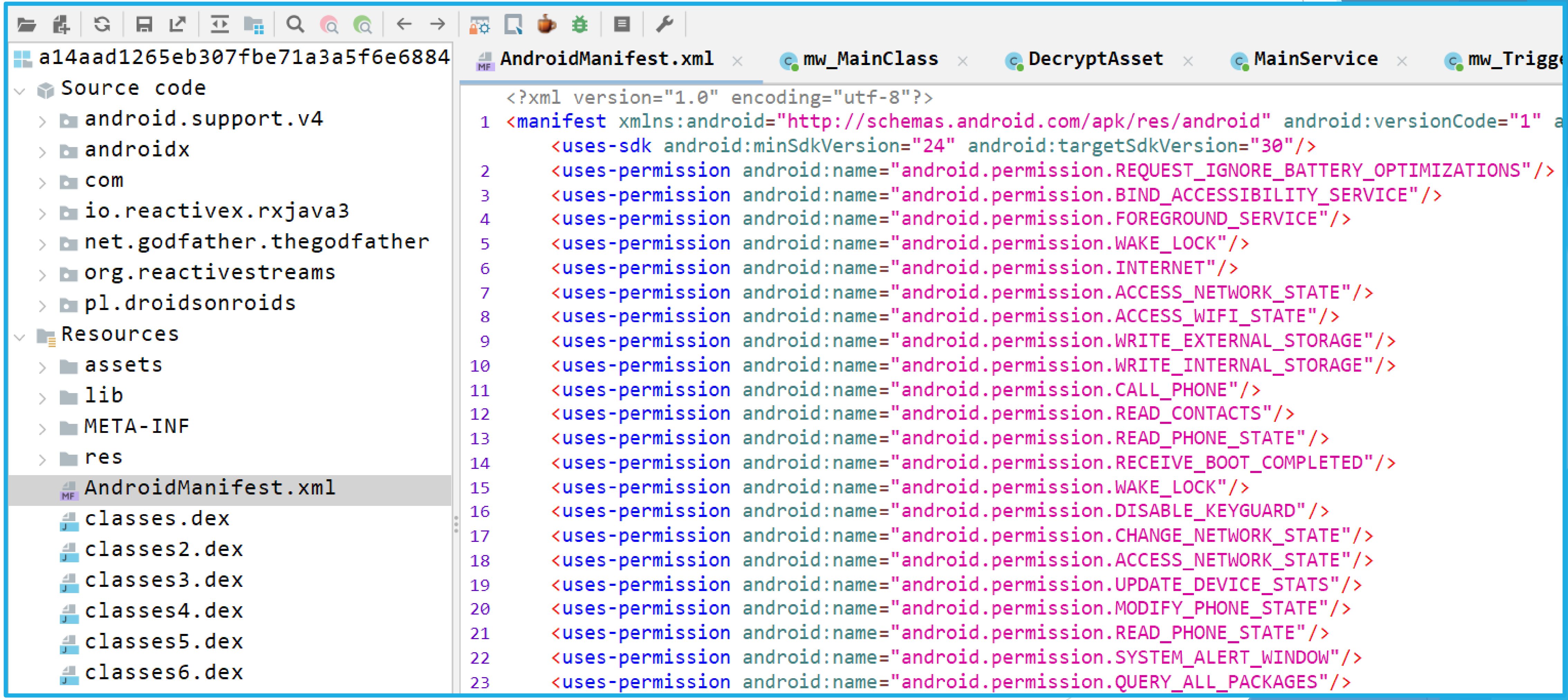
Android Analysis Tools

- JADX: Java decompiler / disassembler for Android
  - https://github.com/skylot/jadx
- Ghidra: C / C++ decompiler / disassembler
  - https://ghidra-sre.org/
- Docker-android: emulator for Android
  - https://github.com/budtmo/docker-android
- Recaf: Up-and-coming Java bytecode editor
  - https://github.com/Col-E/Recaf

Other Resources

- Full Anubis banker analysis (in progress)
  - https://www.youtube.com/watch?v=Vs9Z3NDnVT8
- Hooking Android methods with Frida
  - https://www.youtube.com/watch?v=RJXsvAjZI9U
- Running an Android ARM emulator
  - https://www.youtube.com/watch?v=fTT5hxiMv6I

Permissions

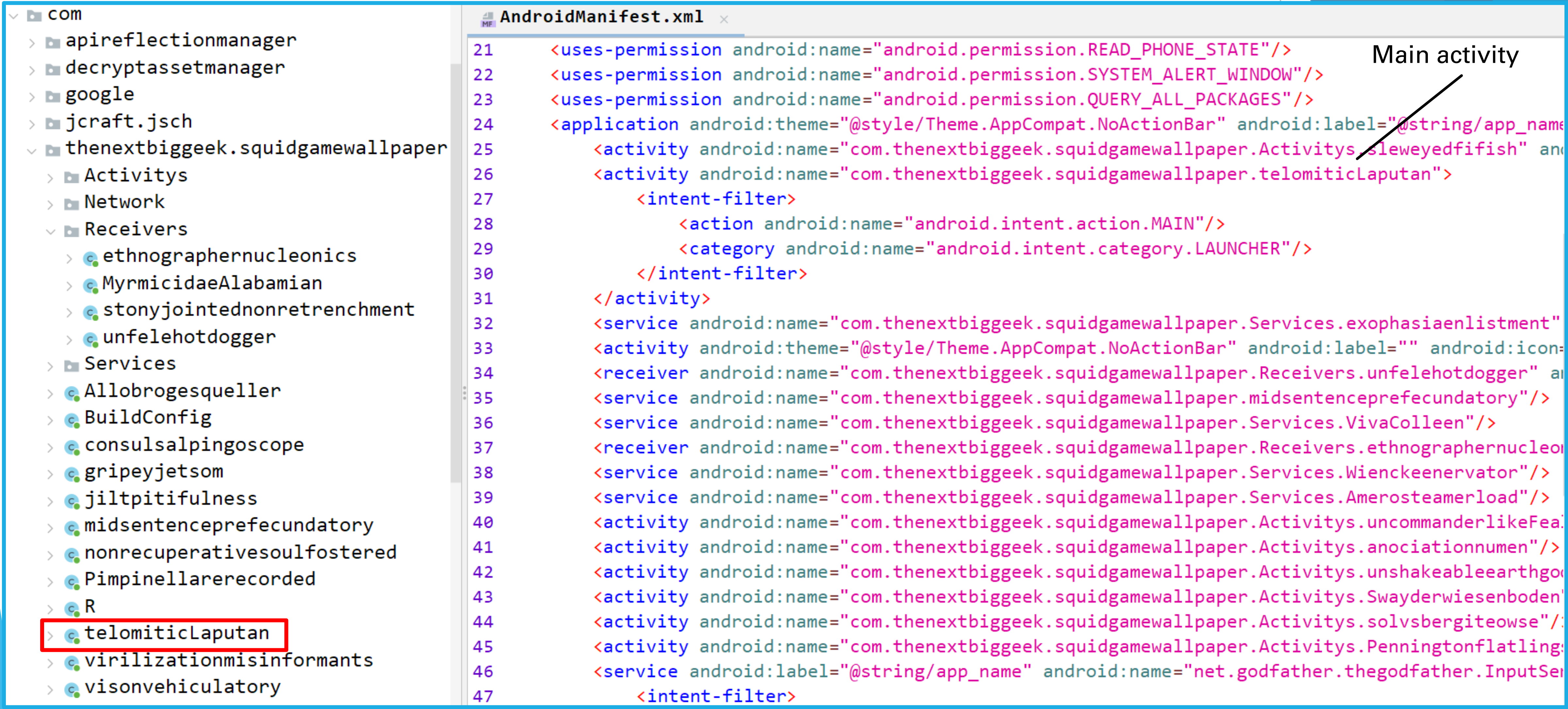


a14aad1265eb307fbe71a3a5f6e6884
- Source code
  - android.support.v4
  - androidx
  - com
  - io.reactivex.rxjava3
  - net.godfather.thegodfather
  - org.reactivestreams
  - pl.droidsonroids
- Resources
  - assets
  - lib
  - META-INF
  - res
  - AndroidManifest.xml
  - classes.dex
  - classes2.dex
  - classes3.dex
  - classes4.dex
  - classes5.dex
  - classes6.dex

AndroidManifest.xml | mw_MainClass | DecryptAsset | MainService | mw_Trigg

```xml
<?xml version="1.0" encoding="utf-8"?>
<manifest xmlns:android="http://schemas.android.com/apk/res/android" android:versionCode="1" a
    <uses-sdk android:minSdkVersion="24" android:targetSdkVersion="30"/>
    <uses-permission android:name="android.permission.REQUEST_IGNORE_BATTERY_OPTIMIZATIONS"/>
    <uses-permission android:name="android.permission.BIND_ACCESSIBILITY_SERVICE"/>
    <uses-permission android:name="android.permission.FOREGROUND_SERVICE"/>
    <uses-permission android:name="android.permission.WAKE_LOCK"/>
    <uses-permission android:name="android.permission.INTERNET"/>
    <uses-permission android:name="android.permission.ACCESS_NETWORK_STATE"/>
    <uses-permission android:name="android.permission.ACCESS_WIFI_STATE"/>
    <uses-permission android:name="android.permission.WRITE_EXTERNAL_STORAGE"/>
    <uses-permission android:name="android.permission.WRITE_INTERNAL_STORAGE"/>
    <uses-permission android:name="android.permission.CALL_PHONE"/>
    <uses-permission android:name="android.permission.READ_CONTACTS"/>
    <uses-permission android:name="android.permission.READ_PHONE_STATE"/>
    <uses-permission android:name="android.permission.RECEIVE_BOOT_COMPLETED"/>
    <uses-permission android:name="android.permission.WAKE_LOCK"/>
    <uses-permission android:name="android.permission.DISABLE_KEYGUARD"/>
    <uses-permission android:name="android.permission.CHANGE_NETWORK_STATE"/>
    <uses-permission android:name="android.permission.ACCESS_NETWORK_STATE"/>
    <uses-permission android:name="android.permission.UPDATE_DEVICE_STATS"/>
    <uses-permission android:name="android.permission.MODIFY_PHONE_STATE"/>
    <uses-permission android:name="android.permission.READ_PHONE_STATE"/>
    <uses-permission android:name="android.permission.SYSTEM_ALERT_WINDOW"/>
    <uses-permission android:name="android.permission.QUERY_ALL_PACKAGES"/>
```

Deconstructing the Manifest



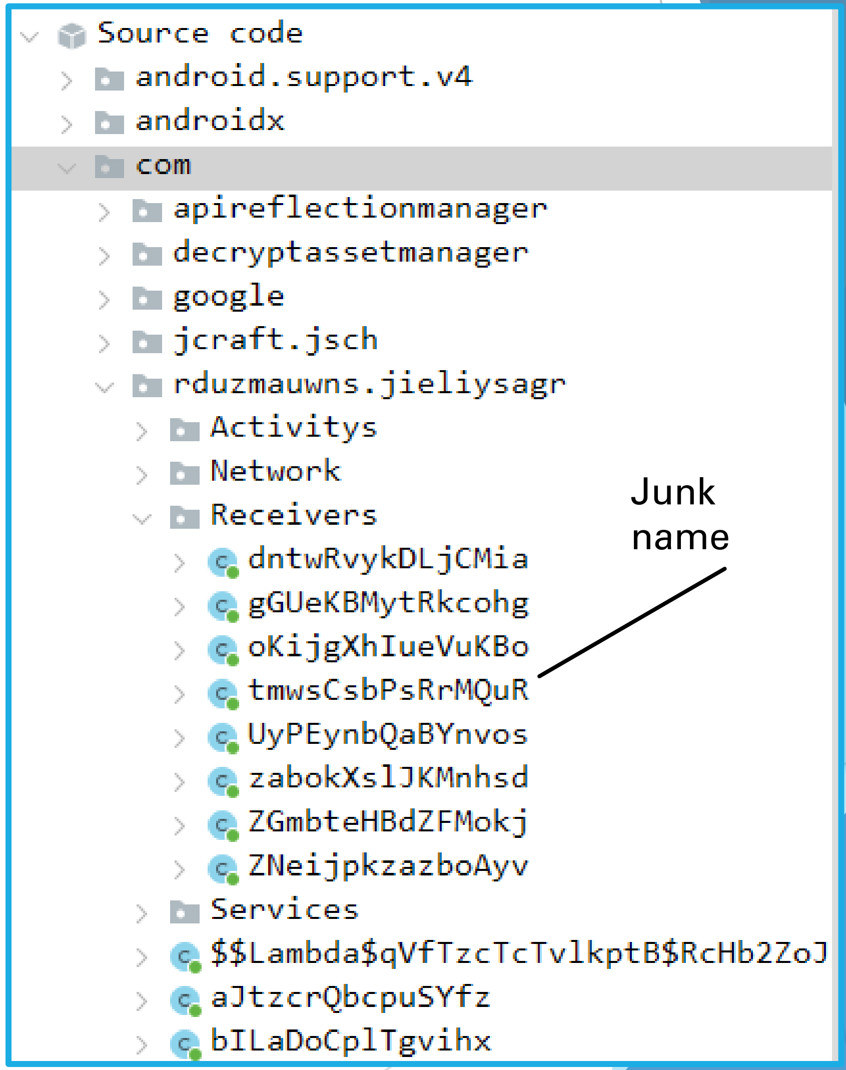
```
com
  apireflectionmanager
  decryptassetmanager
  google
  jcraft.jsch
  thenextbiggeek.squidgamewallpaper
    Activitys
    Network
    Receivers
      ethnographernucleonics
      MyrmicidaeAlabamian
      stonyjointednonretrenchment
      unfelehotdogger
    Services
    Allobrogesqueller
    BuildConfig
    consulsalpingoscope
    gripeyjetsom
    jiltpitifulness
    midsentenceprefecundatory
    nonrecuperativesoulfostered
    Pimpinellarerecorded
    R
    telomiticLaputan
    virilizationmisinformants
    visonvehiculatory
```

AndroidManifest.xml

```
    <uses-permission android:name="android.permission.READ_PHONE_STATE"/>
    <uses-permission android:name="android.permission.SYSTEM_ALERT_WINDOW"/>
    <uses-permission android:name="android.permission.QUERY_ALL_PACKAGES"/>
    <application android:theme="@style/Theme.AppCompat.NoActionBar" android:label="@string/app_name
        <activity android:name="com.thenextbiggeek.squidgamewallpaper.Activitys.sleweyedfifish" an
        <activity android:name="com.thenextbiggeek.squidgamewallpaper.telomiticLaputan">
            <intent-filter>
                <action android:name="android.intent.action.MAIN"/>
                <category android:name="android.intent.category.LAUNCHER"/>
            </intent-filter>
        </activity>
        <service android:name="com.thenextbiggeek.squidgamewallpaper.Services.exophasiaenlistment"
        <activity android:theme="@style/Theme.AppCompat.NoActionBar" android:label="" android:icon=
        <receiver android:name="com.thenextbiggeek.squidgamewallpaper.Receivers.unfelehotdogger" a
        <service android:name="com.thenextbiggeek.squidgamewallpaper.midsentenceprefecundatory"/>
        <service android:name="com.thenextbiggeek.squidgamewallpaper.Services.VivaColleen"/>
        <receiver android:name="com.thenextbiggeek.squidgamewallpaper.Receivers.ethnographernucleo
        <service android:name="com.thenextbiggeek.squidgamewallpaper.Services.Wienckeenervator"/>
        <service android:name="com.thenextbiggeek.squidgamewallpaper.Services.Amerosteamerload"/>
        <activity android:name="com.thenextbiggeek.squidgamewallpaper.Activitys.uncommanderlikeFea
        <activity android:name="com.thenextbiggeek.squidgamewallpaper.Activitys.anociationnumen"/>
        <activity android:name="com.thenextbiggeek.squidgamewallpaper.Activitys.unshakeableearthgo
        <activity android:name="com.thenextbiggeek.squidgamewallpaper.Activitys.Swayderwiesenboden"
        <activity android:name="com.thenextbiggeek.squidgamewallpaper.Activitys.solvsbergiteowse"/
        <activity android:name="com.thenextbiggeek.squidgamewallpaper.Activitys.Penningtonflatling
        <service android:label="@string/app_name" android:name="net.godfather.thegodfather.InputSe
            <intent-filter>
```

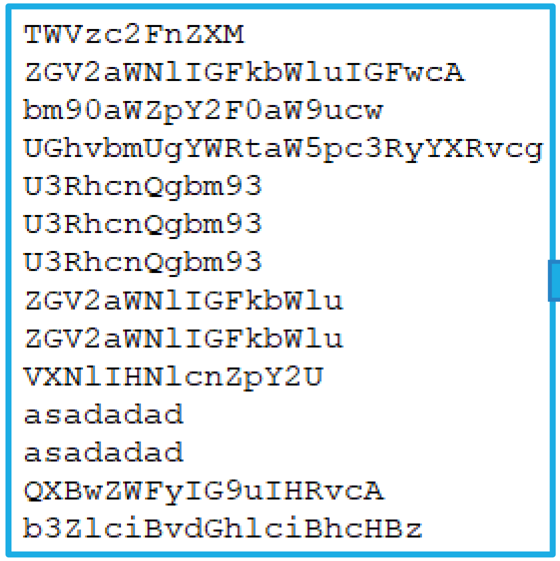
Identifier Renaming

- Rename classes, methods, and variables
- Change to meaningless names
- By default, Android apps include original developer names

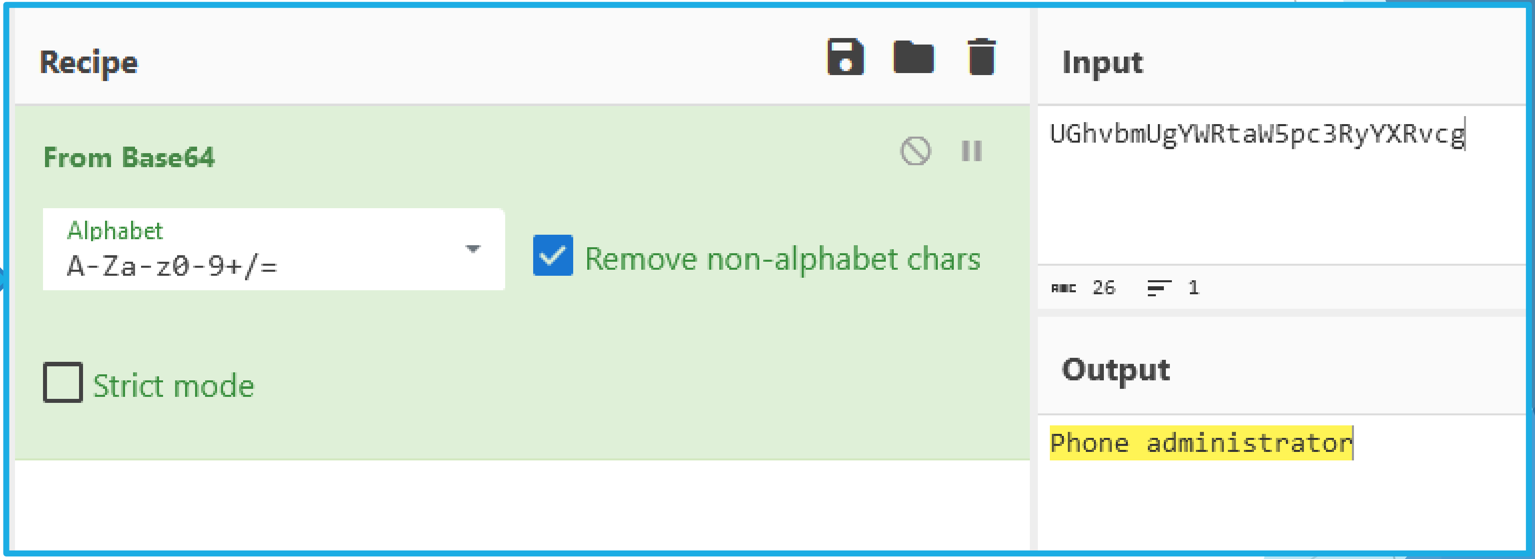


```
Source code
  android.support.v4
  androidx
  com
    apireflectionmanager
    decryptassetmanager
    google
    jcraft.jsch
    rduzmauwns.jieliysagr
      Activitys
      Network
      Receivers
        dntwRvykDLjCMia
        gGUeKBMytRkcohg
        oKijgXhIueVuKBo
        tmwsCsbPsRrMQuR
        UyPEynbQaBYnvos
        zabokXslJKMnhsd
        ZGmbteHBdZFMokj
        ZNeijpkzazboAyv
      Services
      $$Lambda$qVfTzcTcTvlkptB$RcHb2ZoJ
      aJtzcrQbcpuSYfz
      bILaDoCplTgvihx
```

Decoding Strings with Cyberchef



```
TWVzc2FnZXM
ZGV2aWNlIGFkbWluIGFwcA
bm90aWZpY2F0aW9ucw
UGhvbmUgYWRtaW5pc3RyYXRvcg
U3RhcnQgbm93
U3RhcnQgbm93
U3RhcnQgbm93
ZGV2aWNlIGFkbWlu
ZGV2aWNlIGFkbWlu
VXNlIHNlcnZpY2U
asadadad
asadadad
QXBwZWFyIG9uIHRvcA
b3ZlciBvdGhlciBhcHBz
```



Recipe

From Base64

Alphabet: A-Za-z0-9+/=

[✓] Remove non-alphabet chars

[ ] Strict mode

Input

```
UGhvbmUgYWRtaW5pc3RyYXRvcg
```

26 1

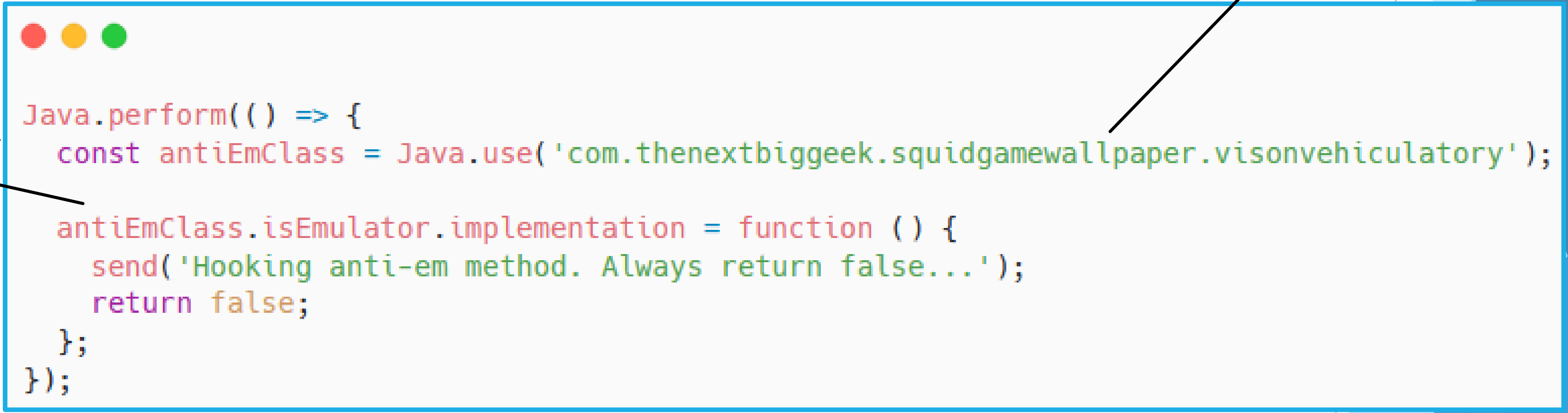
Output

```
Phone administrator
```

Custom Frida JavaScript

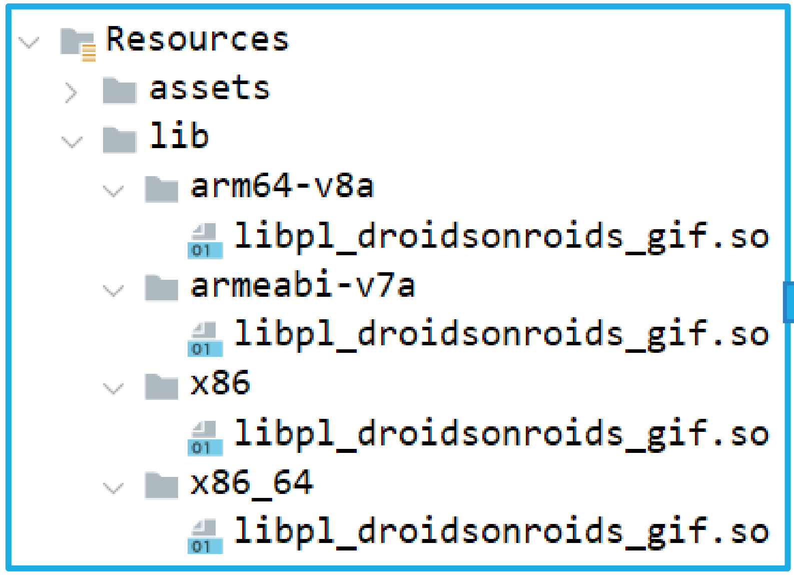
Class to hook

New functionality



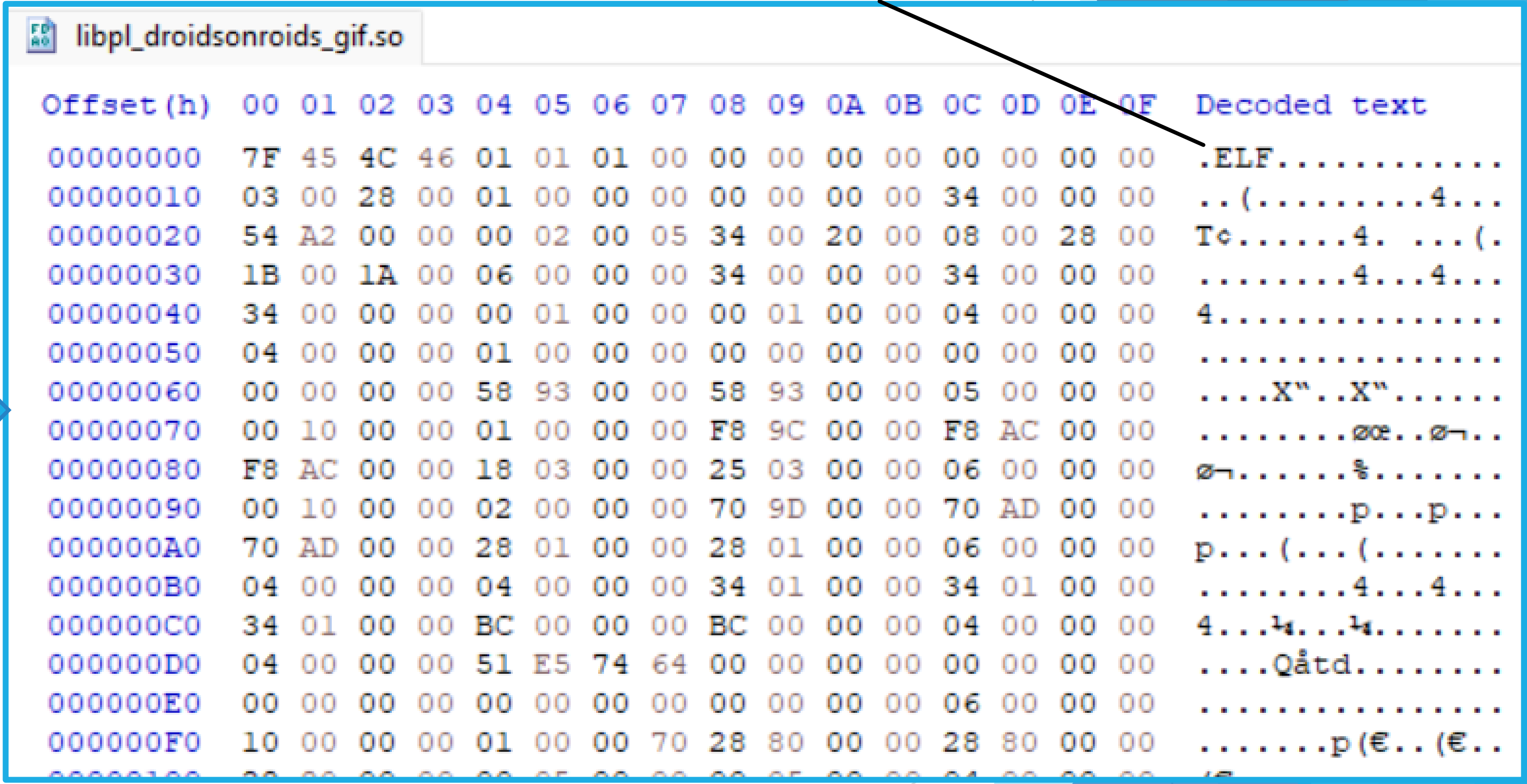
```
Java.perform(() => {
  const antiEmClass = Java.use('com.thenextbiggeek.squidgamewallpaper.visonvehiculatory');

  antiEmClass.isEmulator.implementation = function () {
    send('Hooking anti-em method. Always return false...');
    return false;
  };
});
```

Benign Native Binary



```
Resources
  assets
  lib
    arm64-v8a
      libpl_droidsonroids_gif.so
    armeabi-v7a
      libpl_droidsonroids_gif.so
    x86
      libpl_droidsonroids_gif.so
    x86_64
      libpl_droidsonroids_gif.so
```

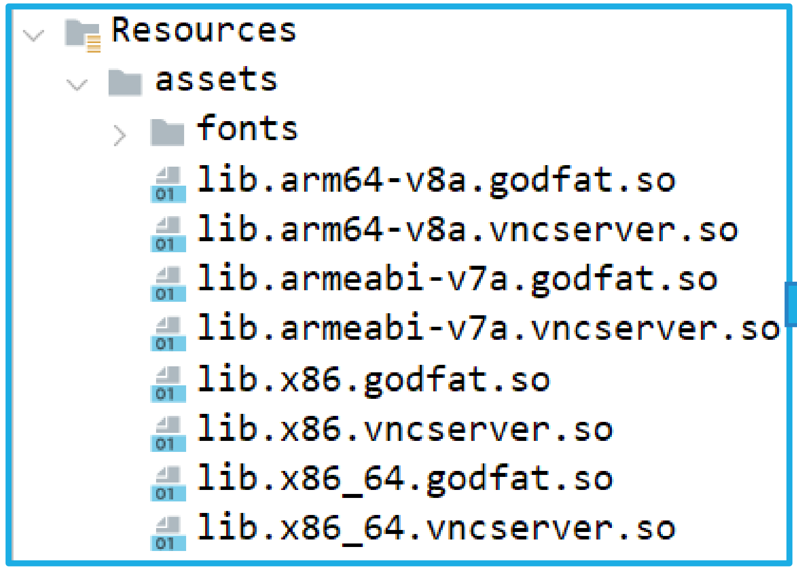
Executable and
Linkable
Format



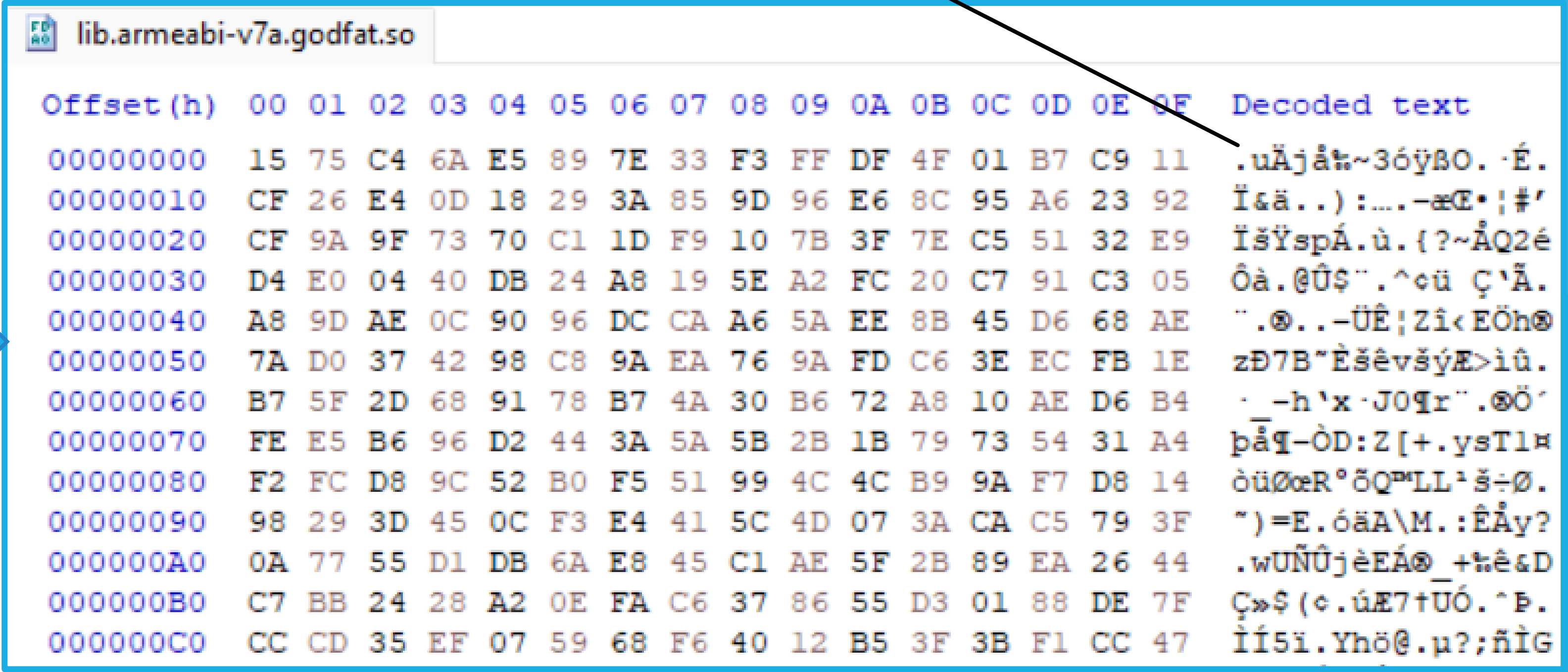
libpl_droidsonroids_gif.so

```
Offset(h) 00 01 02 03 04 05 06 07 08 09 0A 0B 0C 0D 0E 0F  Decoded text

00000000  7F 45 4C 46 01 01 01 00 00 00 00 00 00 00 00 00  .ELF............
00000010  03 00 28 00 01 00 00 00 00 00 00 00 34 00 00 00  ..(.........4...
00000020  54 A2 00 00 00 02 00 05 34 00 20 00 08 00 28 00  T¢......4. ...(.
00000030  1B 00 1A 00 06 00 00 00 34 00 00 00 34 00 00 00  ........4...4...
00000040  34 00 00 00 00 01 00 00 00 01 00 00 04 00 00 00  4...............
00000050  04 00 00 00 01 00 00 00 00 00 00 00 00 00 00 00  ................
00000060  00 00 00 00 58 93 00 00 58 93 00 00 05 00 00 00  ....X“..X“......
00000070  00 10 00 00 01 00 00 00 F8 9C 00 00 F8 AC 00 00  ........øœ..ø¬..
00000080  F8 AC 00 00 18 03 00 00 25 03 00 00 06 00 00 00  ø¬......%.......
00000090  00 10 00 00 02 00 00 00 70 9D 00 00 70 AD 00 00  ........p...p...
000000A0  70 AD 00 00 28 01 00 00 28 01 00 00 06 00 00 00  p...(...(.......
000000B0  04 00 00 00 04 00 00 00 34 01 00 00 34 01 00 00  ........4...4...
000000C0  34 01 00 00 BC 00 00 00 BC 00 00 00 04 00 00 00  4...¼...¼.......
000000D0  04 00 00 00 51 E5 74 64 00 00 00 00 00 00 00 00  ....Qåtd........
000000E0  00 00 00 00 00 00 00 00 00 00 00 00 06 00 00 00  ................
000000F0  10 00 00 00 01 00 00 70 28 80 00 00 28 80 00 00  .......p(€..(€..
```

Malicious Encrypted Native Binaries



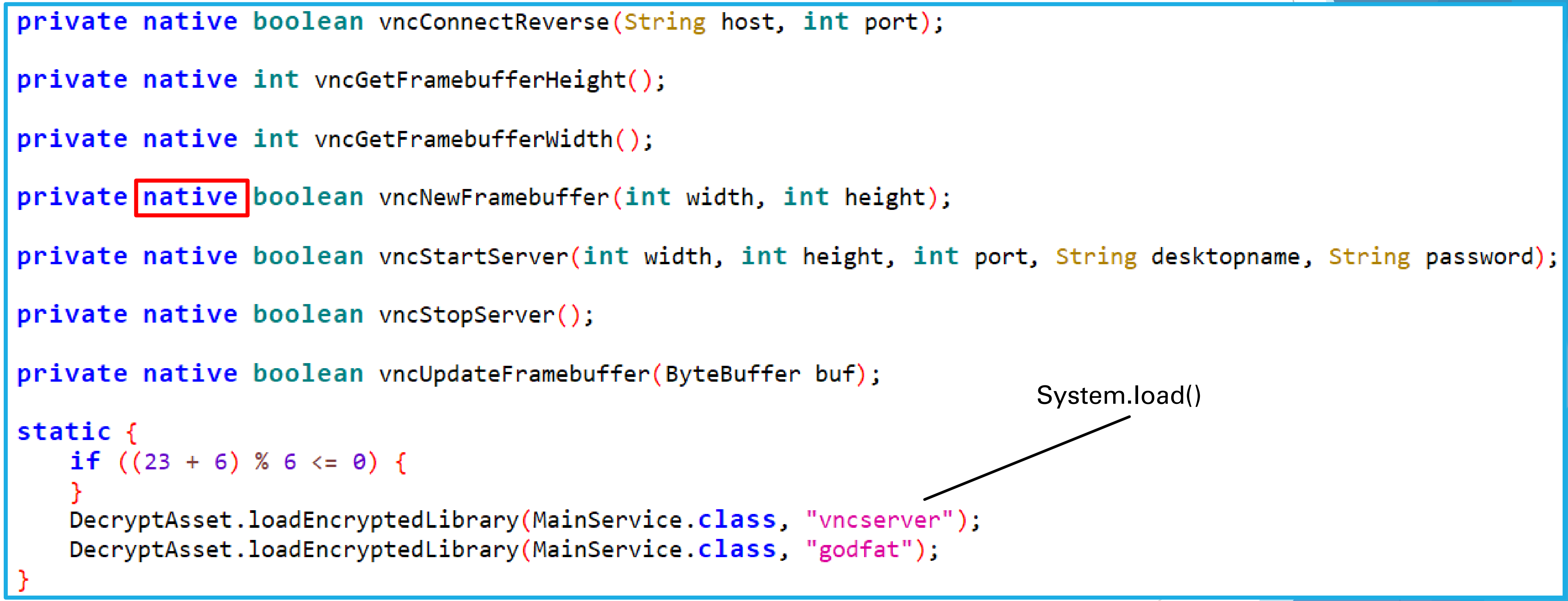
```
Resources
  assets
    fonts
    lib.arm64-v8a.godfat.so
    lib.arm64-v8a.vncserver.so
    lib.armeabi-v7a.godfat.so
    lib.armeabi-v7a.vncserver.so
    lib.x86.godfat.so
    lib.x86.vncserver.so
    lib.x86_64.godfat.so
    lib.x86_64.vncserver.so
```



lib.armeabi-v7a.godfat.so

```
Offset(h) 00 01 02 03 04 05 06 07 08 09 0A 0B 0C 0D 0E 0F  Decoded text

00000000  15 75 C4 6A E5 89 7E 33 F3 FF DF 4F 01 B7 C9 11  .uÄjå‰~3óÿßO.·É.
00000010  CF 26 E4 0D 18 29 3A 85 9D 96 E6 8C 95 A6 23 92  Ï&ä..):….–æŒ•¦#’
00000020  CF 9A 9F 73 70 C1 1D F9 10 7B 3F 7E C5 51 32 E9  ÏšŸspÁ.ù.{?~ÅQ2é
00000030  D4 E0 04 40 DB 24 A8 19 5E A2 FC 20 C7 91 C3 05  Ôà.@Û$¨.^¢ü Ç‘Ã.
00000040  A8 9D AE 0C 90 96 DC CA A6 5A EE 8B 45 D6 68 AE  ¨.®..–ÜÊ¦Zî‹EÖh®
00000050  7A D0 37 42 98 C8 9A EA 76 9A FD C6 3E EC FB 1E  zÐ7B˜ÈšêvšýÆ>ìû.
00000060  B7 5F 2D 68 91 78 B7 4A 30 B6 72 A8 10 AE D6 B4  ·_-h‘x·J0¶r¨.®Ö´
00000070  FE E5 B6 96 D2 44 3A 5A 5B 2B 1B 79 73 54 31 A4  þå¶–ÒD:Z[+.ysT1¤
00000080  F2 FC D8 9C 52 B0 F5 51 99 4C 4C B9 9A F7 D8 14  òüØœR°õQ™LL¹š÷Ø.
00000090  98 29 3D 45 0C F3 E4 41 5C 4D 07 3A CA C5 79 3F  ˜)=E.óäA\M.:ÊÅy?
000000A0  0A 77 55 D1 DB 6A E8 45 C1 AE 5F 2B 89 EA 26 44  .wUÑÛjèEÁ®_+‰ê&D
000000B0  C7 BB 24 28 A2 0E FA C6 37 86 55 D3 01 88 DE 7F  Ç»$(¢.úÆ7†UÓ.ˆÞ.
000000C0  CC CD 35 EF 07 59 68 F6 40 12 B5 3F 3B F1 CC 47  ÌÍ5ï.Yhö@.µ?;ñÌG
```

Native References in Java



```
private native boolean vncConnectReverse(String host, int port);

private native int vncGetFramebufferHeight();

private native int vncGetFramebufferWidth();

private native boolean vncNewFramebuffer(int width, int height);

private native boolean vncStartServer(int width, int height, int port, String desktopname, String password);

private native boolean vncStopServer();

private native boolean vncUpdateFramebuffer(ByteBuffer buf);

static {
    if ((23 + 6) % 6 <= 0) {
    }
    DecryptAsset.loadEncryptedLibrary(MainService.class, "vncserver");
    DecryptAsset.loadEncryptedLibrary(MainService.class, "godfat");
}
```