(IN-)SECURITY OF SMARTPHONE ANTI-VIRUS AND SECURITY APPS

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Who are we

Stephan

- Mobile Security Researcher at Fraunhofer SIT
- Enjoys teaching students in Android Hacking
- @teamsik

Siegfried

- 4th year PhD Student at TU Darmstadt/ Fraunhofer SIT
- Static and Dynamic Code Analysis
- @teamsik

Vulnerabilities in antivirus tools: What does it mean for enterprises?

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Google Security Researcher Slams Antivirus Software For Its Vulnerabilities

Research shows antivirus products vulnerable to attack

A Google researcher has been reporting severe vulnerabilities in

s tools, such as

Security App Features on Mobile

Security App Features on Mobile

Secure Browsing

Security App Features on Mobile

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Signature Update

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Secure Browsing

Signature Update

Realtime Monitoring

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Theft Protection

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Security App Features on Mobile

SPAM Protection

Secure Browsing

Theft Protection

Signature Update

Premium Features

Realtime Monitoring

Outline

- **Analyzed** Apps
- Excerpt of Implementation **Flaws** and **Attack** Types
  - Business Model
  - Local Denial of Service
  - Man-in-the-Middle Attacks
- Overview of **All Findings**
- Our **Experiences** during the **Responsible Disclosure** Process
- Summary

Analyzed Android Apps

App	GooglePlay Downloads
AndroHelm	1-5m
Malwarebytes	5-10m
ESET	5-10m
Avira	10-50m
Kaspersky	10-50m
McAfee	10-50m
CM Security	100-500m

Bussines Model Attack


AndroHelm Security
AntiVirus app
AndroHelm Security
Virenschutz
AndroHelm Security
9,99 €
AntiVirus for Tablet
AndroHelm Security
10,99 €
AntiVirus Security
AndroHelm Security
129,99 €
AntiVirus Android
AndroHelm Security
20,85 €
AntiVirus Android
AndroHelm Security
99,99 €

Client Side License Verification

```
…
this.toast("Thank you for upgrading to PRO!");

//shared pref value set to true
this.prefs.putBoolean("isPro", true);
…
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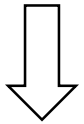

write value to .xml file

```
<?xml version='1.0' encoding='utf-8' standalone='yes' ?>
<map>
    <int name="dialogShowTimes" value="1" />
    <boolean name="hasDatabase" value="true" />
    <string name="lastFragment"></string>
    <boolean name="isPro" value="true"
</map>
```

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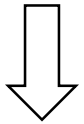

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    <string name="lastFragment"></string>
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</map>
```
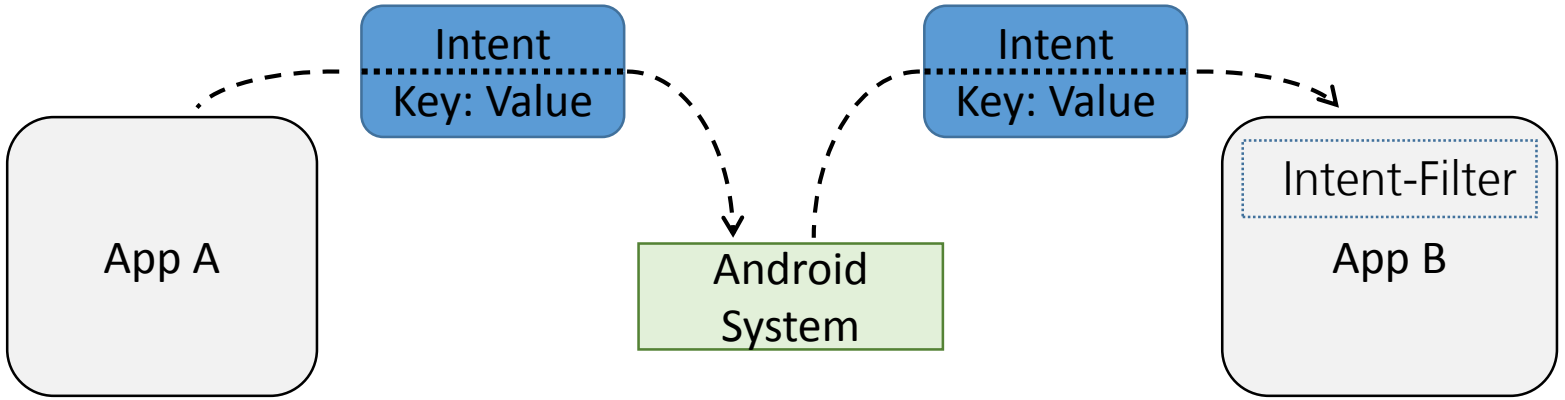
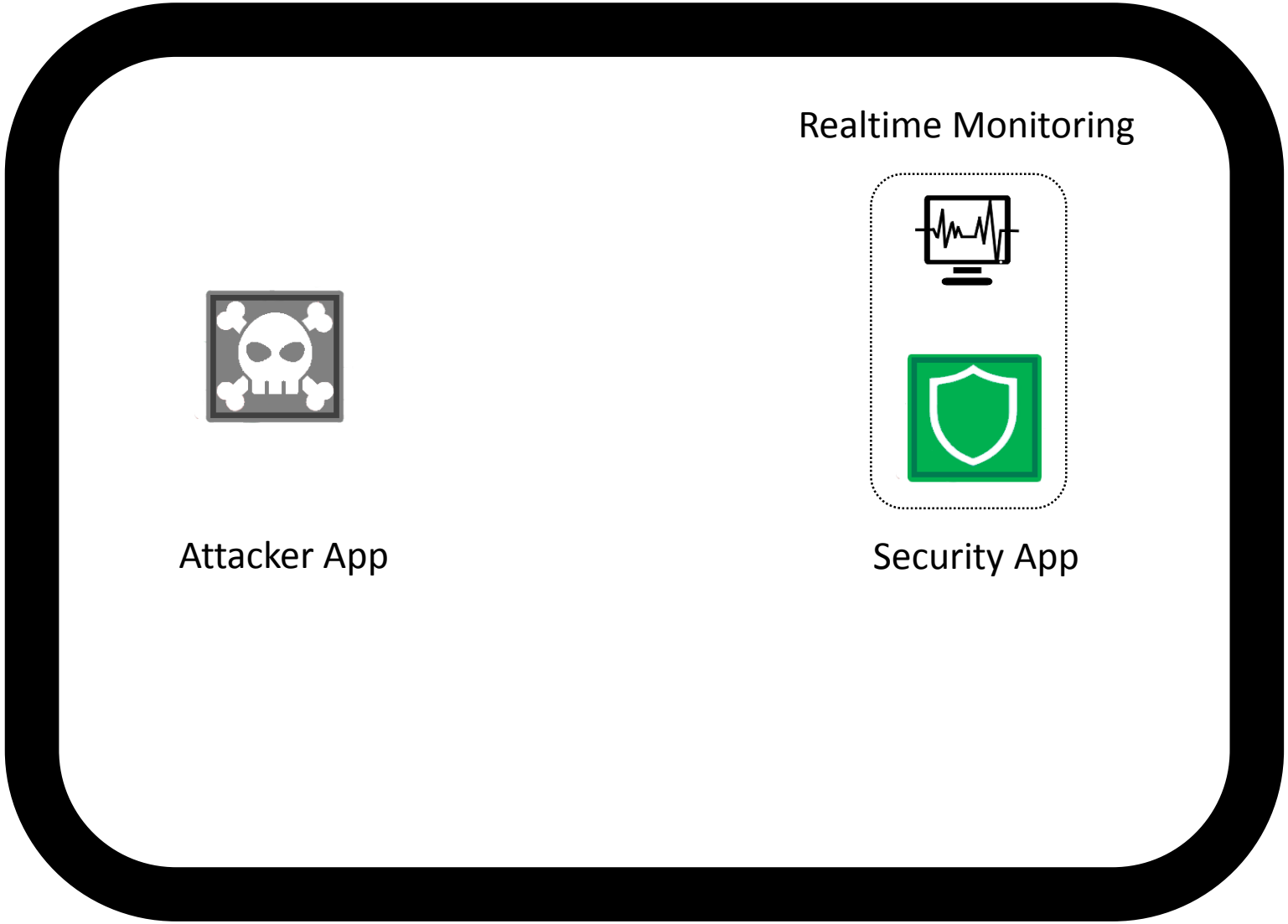
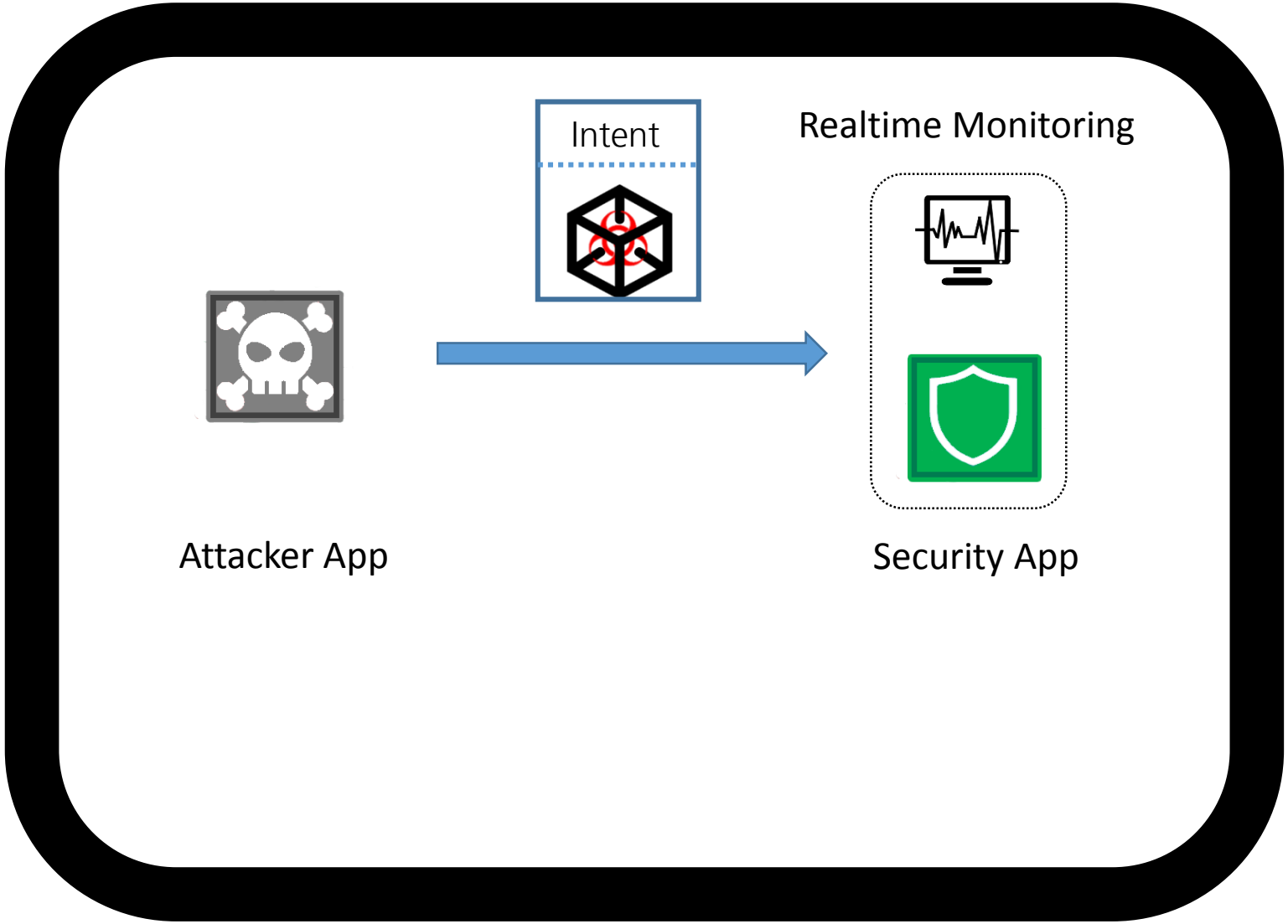

Every user can set this value !

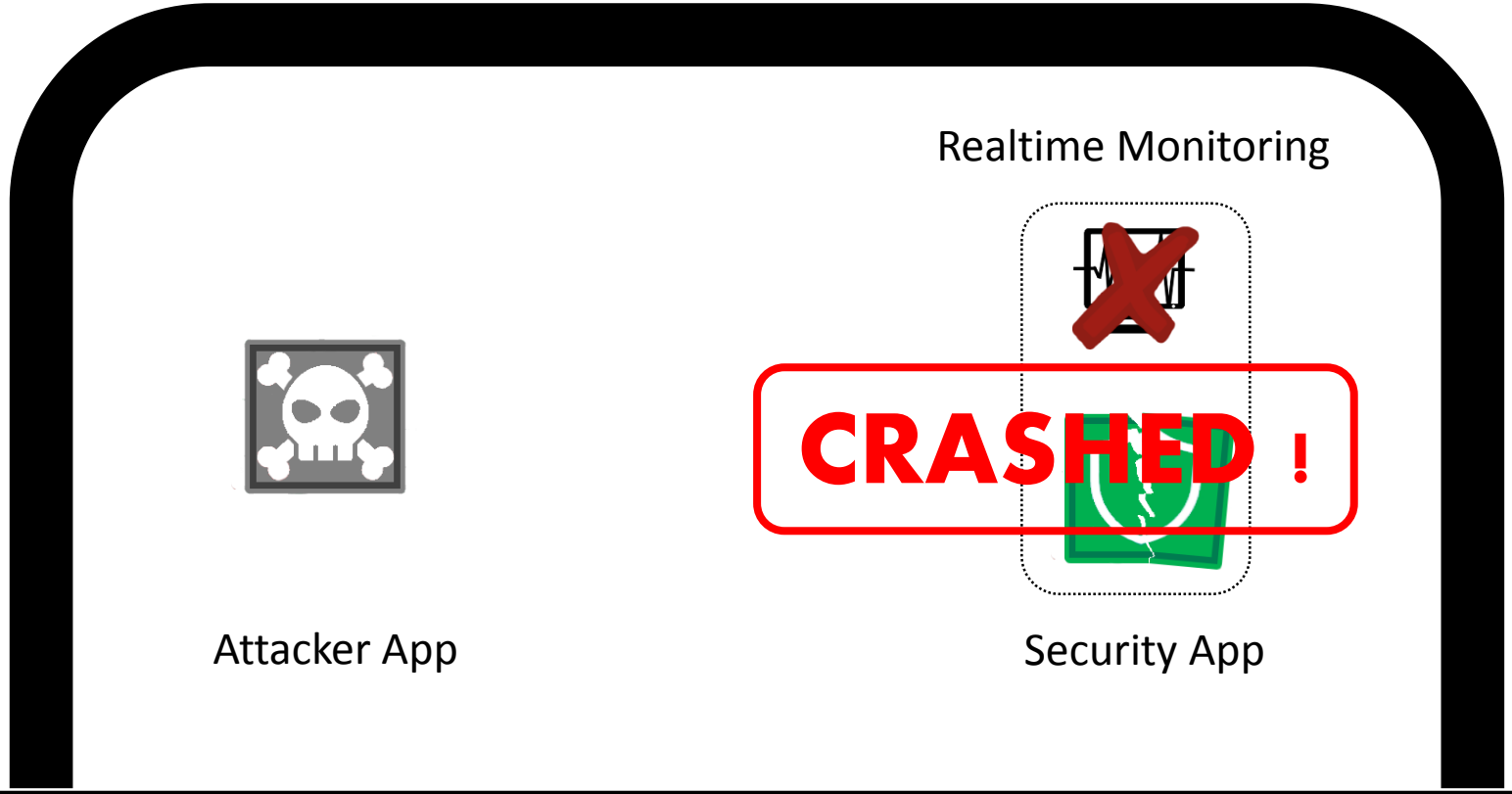
Local Denial of Service

Inter App Communication




Realtime Monitoring
Attacker App
Security App


Intent
Realtime Monitoring
Attacker App
Security App




```
Log output:
Java.lang.RuntimeException: Unable to start receiver
com.androhelm.antivirus.receivers.SMSMonitor: java.lang.NullPointerException
…
com.android.internal.os.ZygoteInit$MethodAndArgsCaller.run(ZygoteInit.java:793)
E/AndroidRuntime(16060): at com.android.internal.os.ZygoteInit.main(ZygoteInit.java:560)
E/AndroidRuntime(16060): Caused by: java.lang.NullPointerException
com.androhelm.antivirus.receivers.SMSMonitor.onReceive(SMSMonitor.java:31)E/AndroidRuntime(16060): at
E/AndroidRuntime(16060): ... 10 more
```

Implementation Faults

- **Missing checks** of intent **payload**, cause ***exceptions***
- **Missing *exception*** handling will **crash whole** application

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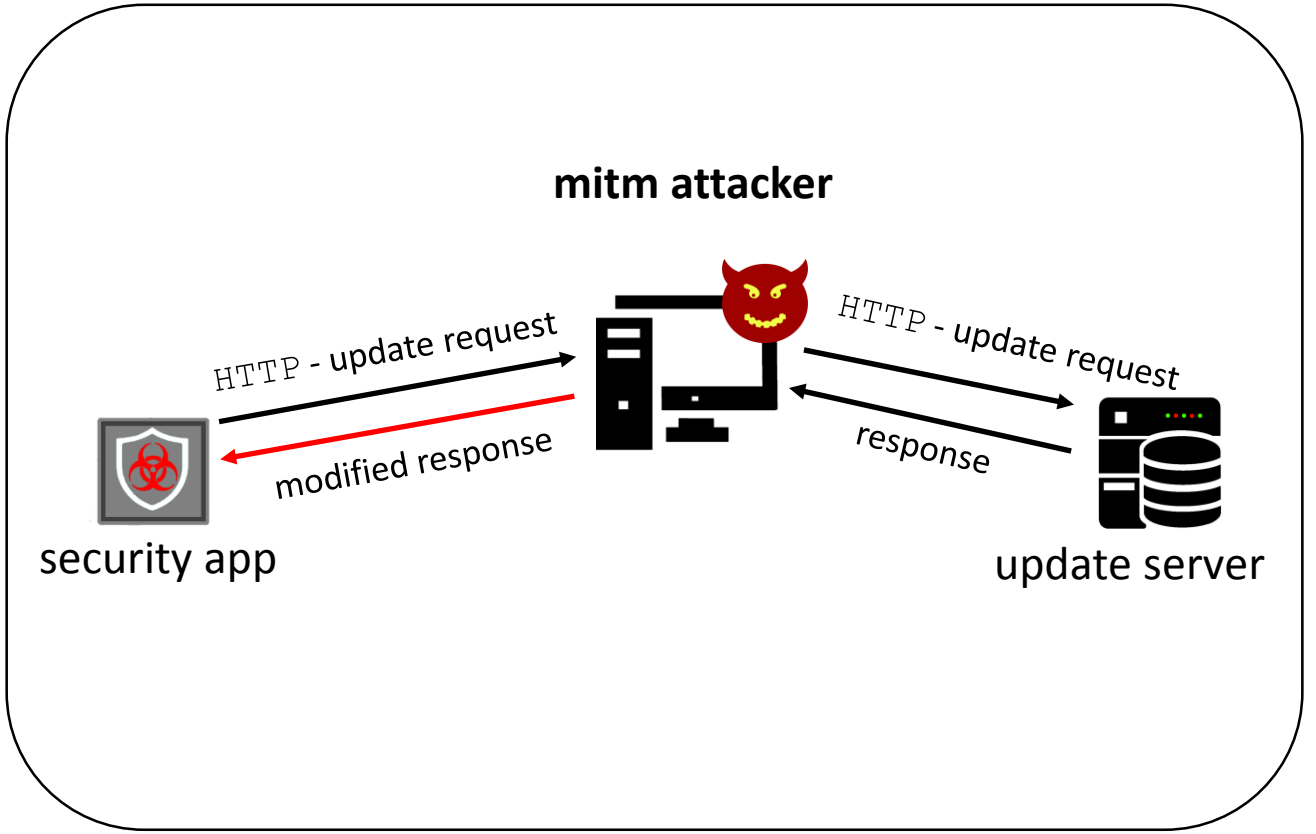
- Example: `null-Intent`

```
1)public void onReceive(Context c, Intent intent) {
2)     //missing check if intent is null
3)     Bundle bundle = intent.getExtras();
4)      if(bundle != null) {
5)            Object o = bundle.get("pdus");
```

Man-in-the-Middle Attacks

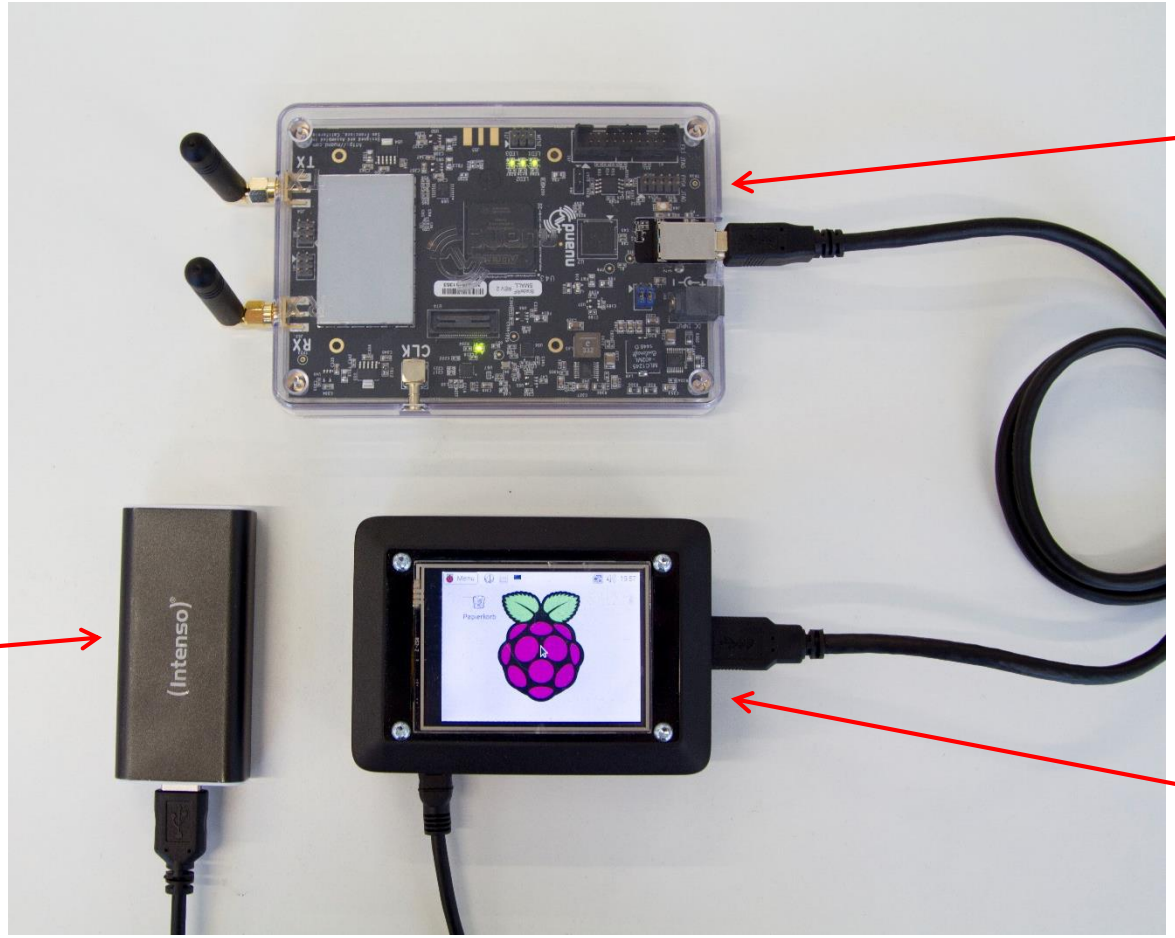
Man-in-the-Middle Attacks

- Smartphone is a **wireless medium**
- Communication over **HTTP**
  - **No authentication**
  - **Broken** self-made **integrity** protection
  - **Broken** self-made **encryption**
- Communication over **HTTPS**
  - **Broken certificate validation**



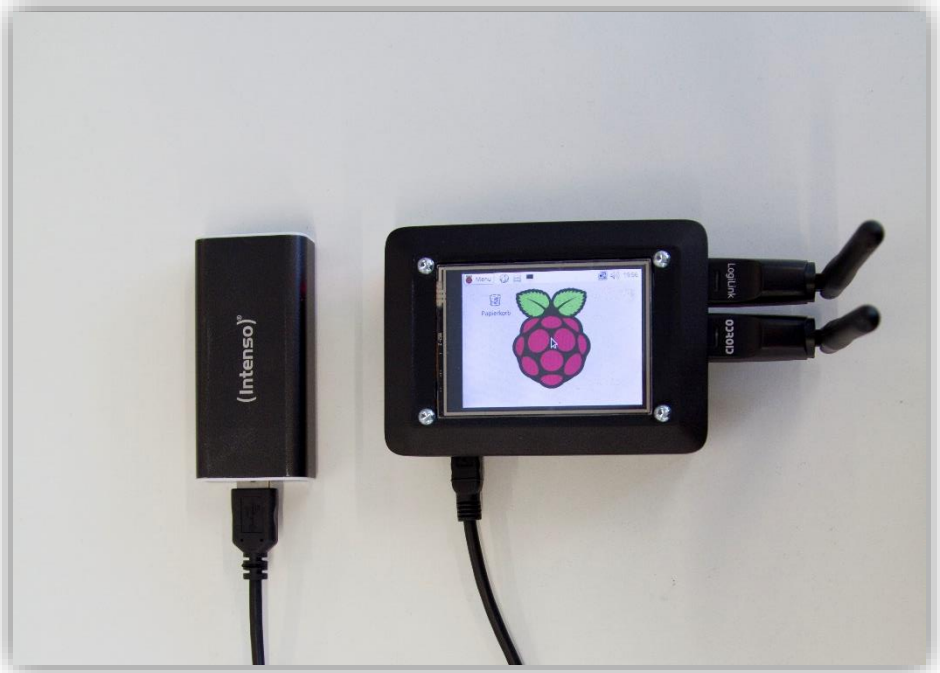
Rogue GSM Hotspot

- Cost: ~ 300 $



Mitm WI-FI Hotspot

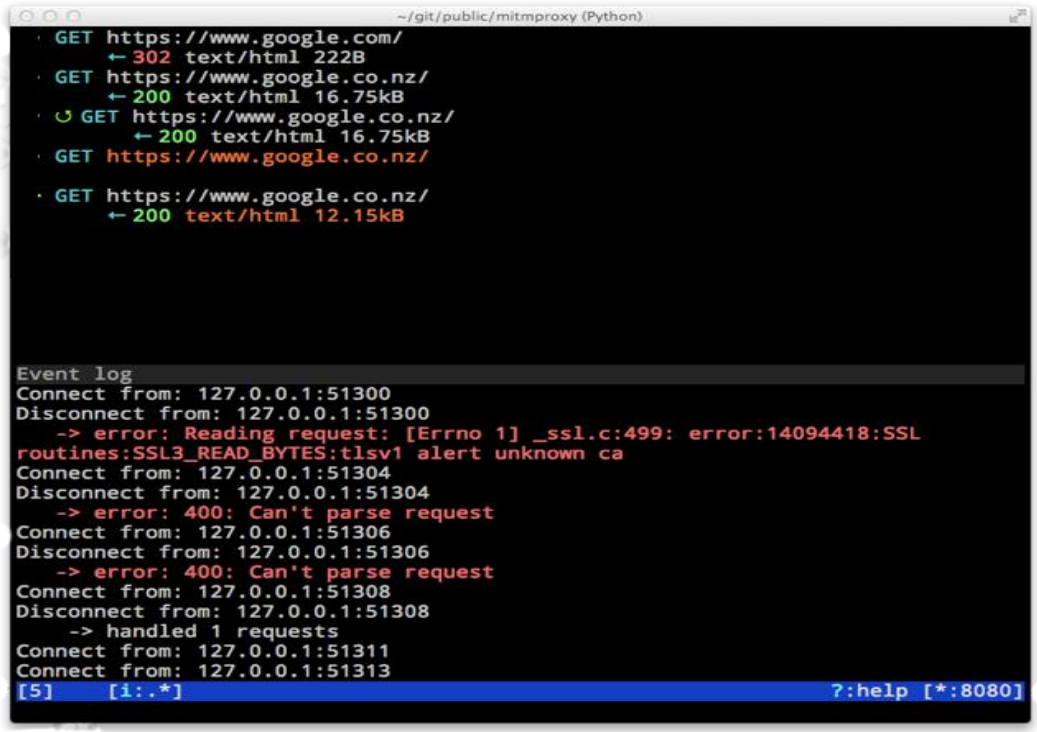
- Cost: ~60$



OR

Arp-Spoofing

- Cost: **arpspoof**, **iptables** and **(mitm)-proxy** are for free !



Remote Code Injection Example

Special zip Entry

```
/tmp$ unzip -l zipfile.zip
Archive:  zipfile.zip
  Length      Date    Time    Name
---------  ---------- -----   ----
       22  2016-06-28 13:49   ../../../tmp/dir2/badfile.txt
       24  2016-06-28 13:43   file1.txt
---------                     -------
       46                     2 files
```

Unzip

```
/tmp$ unzip zipfile.zip -d ./dir1/
Archive:  zipfile.zip
warning:  skipped "../" path component(s) in ../../../tmp/dir2/badfile.txt
 extracting: ./dir1/tmp/dir2/badfile.txt
 extracting: ./dir1/file1.txt
```

Unzip

```
/tmp$ unzip zipfile.zip -d ./dir1/
Archive:  zipfile.zip
warning:  skipped "../" path component(s) in ../../../tmp/dir2/badfile.txt
 extracting: ./dir1/tmp/dir2/badfile.txt
 extracting: ./dir1/file1.txt
```

```
/tmp$ find /tmp/dir1/
/tmp/dir1/
/tmp/dir1/file1.txt
/tmp/dir1/tmp
/tmp/dir1/tmp/dir2
/tmp/dir1/tmp/dir2/badfile.txt
/tmp$
```

No escaping

```
/tmp$ unzip -: zipfile.zip -d ./dir1/
Archive:  zipfile.zip
 extracting: ./dir1/../../../tmp/dir2/badfile.txt
 extracting: ./dir1/file1.txt
```

No escaping

```
/tmp$ unzip -: zipfile.zip -d ./dir1/
Archive:  zipfile.zip
 extracting: ./dir1/../../../tmp/dir2/badfile.txt
 extracting: ./dir1/file1.txt
```

```
/tmp$ ls /tmp/dir1/
      file1.txt

/tmp$ ls /tmp/dir2/
      badfile.txt
```

Observed Update Traffic

Observed Update Traffic

GET-Requests of Application:

```
…
http://downloads7.xxxxxxxx-labs.com/bases/upd/upd-0607g.xml
http://ipm.xxxxxxxx.com/600eb07a-2926-4407-b014-d3e8c77b0086.zip
http://ipm. xxxxxxxx.com/eeea9321-5eac-4709-9046-8475ee951c82.zip
http://downloads7.xxxxxxxx-abs.com/bases/mobile/ksrm//rootdetector.jar
…
```

Observed Update Traffic

replace .zip file with attack file

GET-Requests of Application:

```
…
http://downloads7.xxxxxxxx-labs.com/bases/upd/upd-0607g.xml
http://ipm.xxxxxxxx.com/600eb07a-2926-4407-b014-d3e8c77b0086.zip
http://ipm.xxxxxxxx.com/eeea9321-5eac-4709-9046-8475ee951c82.zip
http://downloads7.xxxxxxxx-abs.com/bases/mobile/ksrm//rootdetector.jar
…
```

Content of the Attack File

```
unzip -l 600eb07a-2926-4407-b014-d3e8c77b0086.zip
Archive:  600eb07a-2926-4407-b014-d3e8c77b0086.zip
  Length      Date    Time    Name
---------  ---------- -----   ----
       16  2015-09-15 18:57   ../../../../../../../../../../../../
../../../../../../../../../../../data/data/com.kms.free/app_bases/pdm.jar
     4042  2015-08-28 18:49   1000_768.css
     6078  2015-08-28 18:49   AntiVirus_Premium.html
      335  2015-08-28 18:49   [Content_Types].xml
      867  2015-08-28 18:49   meta.xml
     3216  2015-08-28 18:49   respond.min.js
```

Structure of Target App Folder

```
./app_bases/pdm.cfg
./app_bases/pdm.jar
.
.
.
.
./some_other_files
.
.
.
```

contains classes.dex
(executable)

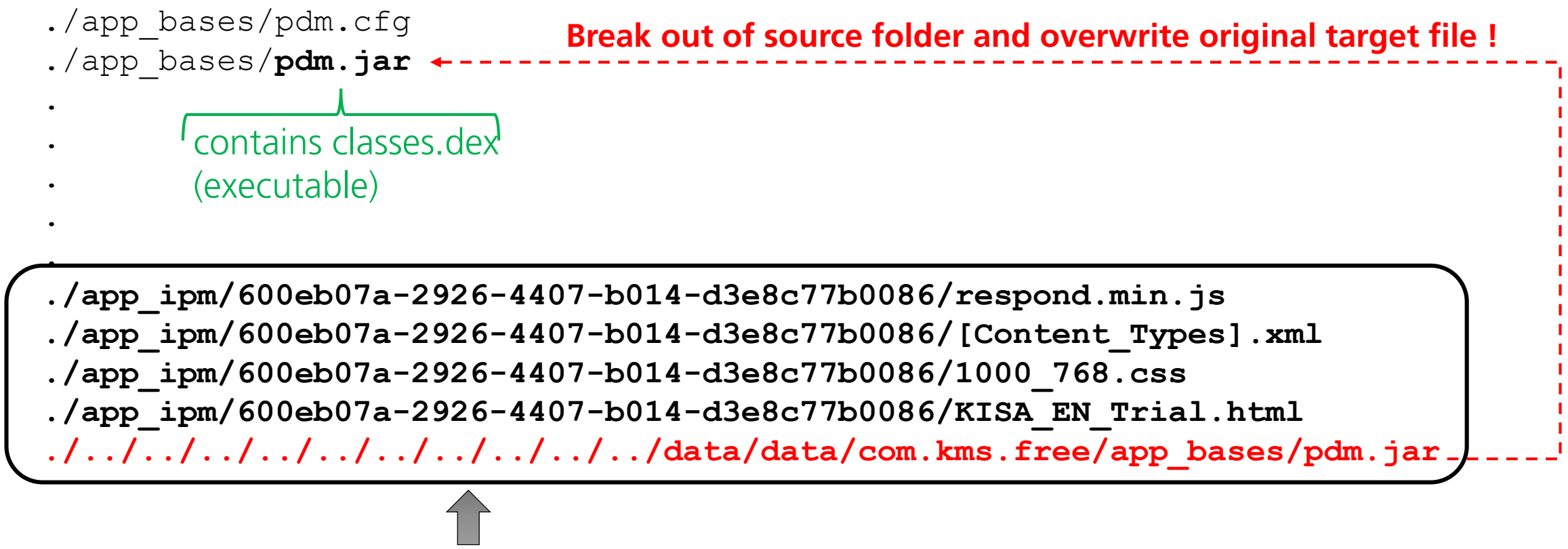
Unzip Received File

```
./app_bases/pdm.cfg
./app_bases/pdm.jar
.
.
.
.
.
./app_ipm/600eb07a-2926-4407-b014-d3e8c77b0086/respond.min.js
./app_ipm/600eb07a-2926-4407-b014-d3e8c77b0086/[Content_Types].xml
./app_ipm/600eb07a-2926-4407-b014-d3e8c77b0086/1000_768.css
./app_ipm/600eb07a-2926-4407-b014-d3e8c77b0086/KISA_EN_Trial.html
./../../../../../../../../../../data/data/com.kms.free/app_bases/pdm.jar
```

contains classes.dex (executable)

Advertisement files + attacker code extracted from zip archive !

Overwrite Original File



Injected Code

```
./app_bases/pdm.cfg
./app_bases/pdm.jar
.
.
.
.
.
```

contains classes.dex
with injected code

Injected File with attacker code !

```
./app_ipm/600eb07a-2926-4407-b014-d3e8c77b0086/respond.min.js
./app_ipm/600eb07a-2926-4407-b014-d3e8c77b0086/[Content_Types].xml
./app_ipm/600eb07a-2926-4407-b014-d3e8c77b0086/1000_768.css
./app_ipm/600eb07a-2926-4407-b014-d3e8c77b0086/KISA_EN_Trial.html
```

Advertisement files transfered by a zip archive !

Summary of Findings

	AndroHelm	Avira	CM	ESET	Kaspersky	McAfee	Malwarebytes
DOS	X	X				X	x
Premium	X			X			
Wipe/Lock	X						
HTTP		X	X		X		X
ScanEngine		X	X				X
Tapjacking			X				
RCE			X		X		
SSL Vuln				X			X
Crypto				X			X
XSS						X	

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Responsible Disclosure

- 6/7 vendors fixed vulnerabilities

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  - Expired public key
  - PGP key was not matching with email address
  - No or less feedback about fixing

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  - No or less feedback about fixing

- One did not reply – but contacted at VB2015 ☺

Lessons learned…

- Do external code audits on your apps
- Room for improvement in the RD process
- Vulnerabilities in mobile apps can be also found in the PC counterpart (cross check)
- Also security software can contain vulnerabilites

sit4.me/av-advisories

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