AndroTotal

A Scalable Framework for Android Antimalware Testing

Andrea Valdi, **Federico Maggi**, **Stefano Zanero**

Politecnico di Milano, **DEIB**

fede@maggi.cc

Roadmap

1. Threats and protections
2. Limitations
3. Evaluating antimalware
4. AndroTotal
5. Status

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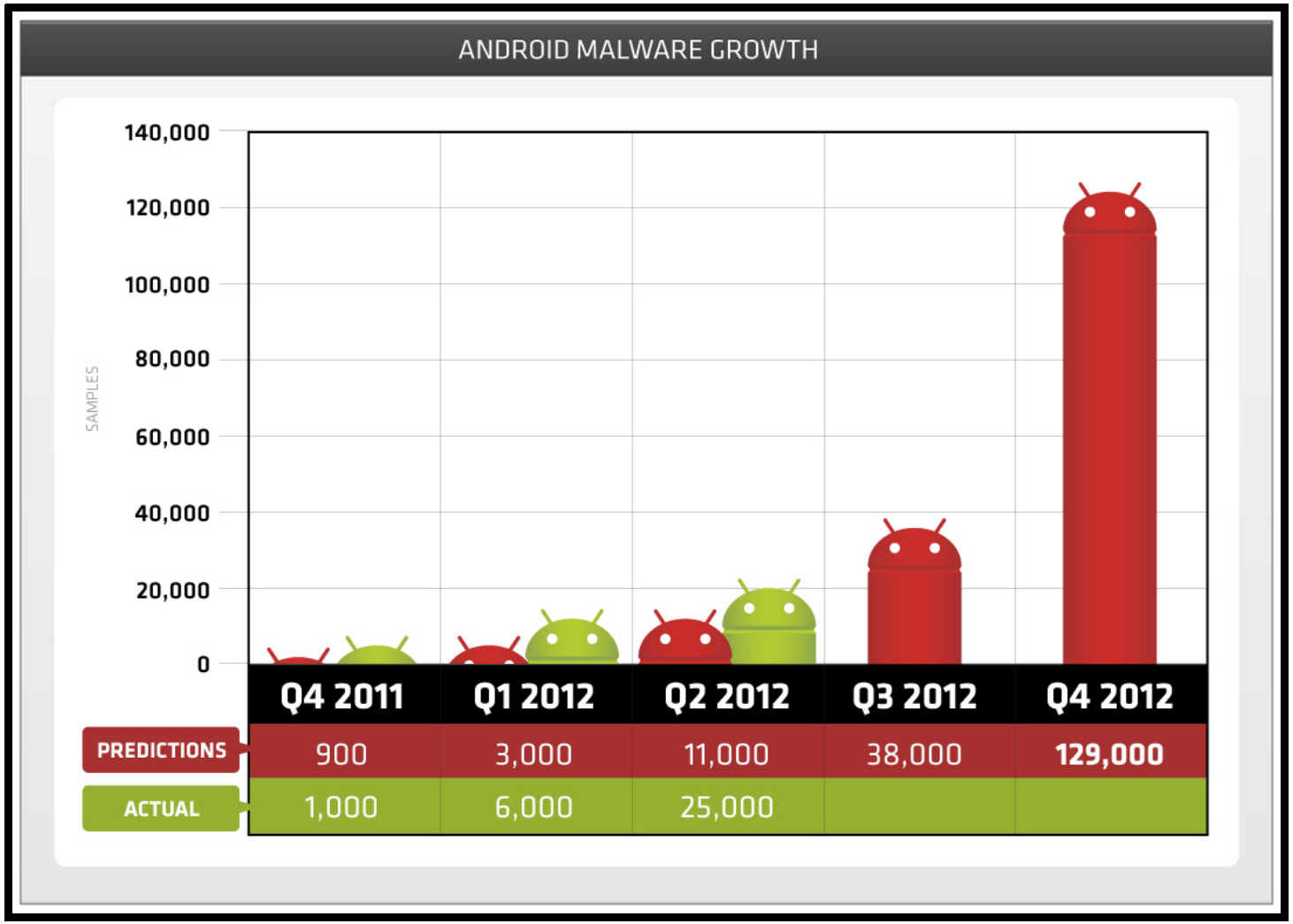
Android Facts

- Android is the most popular mobile platform
- Rich marketplaces stocked with apps
- Very attractive target for attackers

Growth of Malicious Apps



http://blog.trendmicro.com/trendlabs-security-intelligence/byod-a-leap-of-faith-for-enterprise-users/

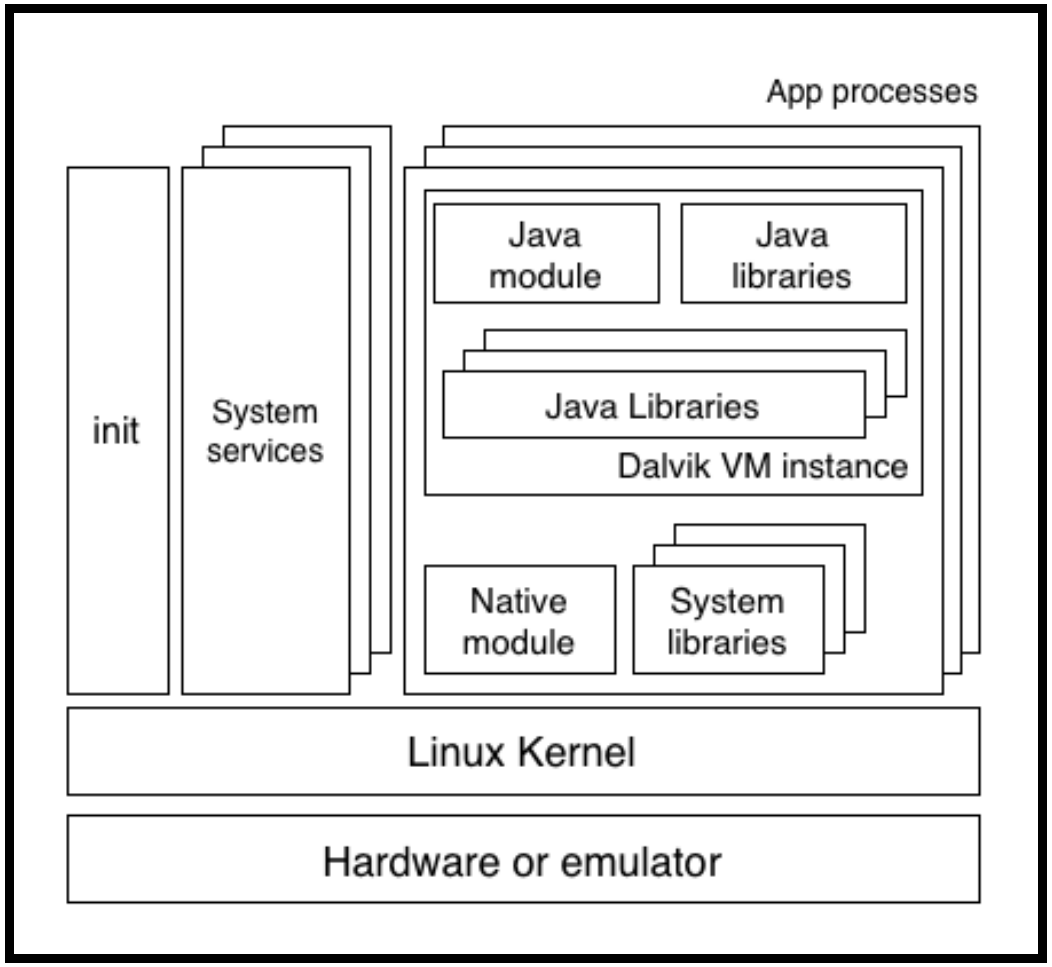
Attackers Goals

- Steal sensitive data (intercept texts or calls)
- Turn devices into bots (perform malicious actions)
- Financial gain (call or text premium numbers)

Android Security Approach

- Official apps on Google Play are vetted upon submission
- "Proprietary" JVM (Dalvik) runtime environment
- One Dalvik process per app
- Isolated processes with distinct `uid`, `gid`
- "Sensitive" operations require permissions

Android Architecture



Consequence

An app (process) cannot interfere
with another app's memory or filesystem.

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Antimalware Limitations

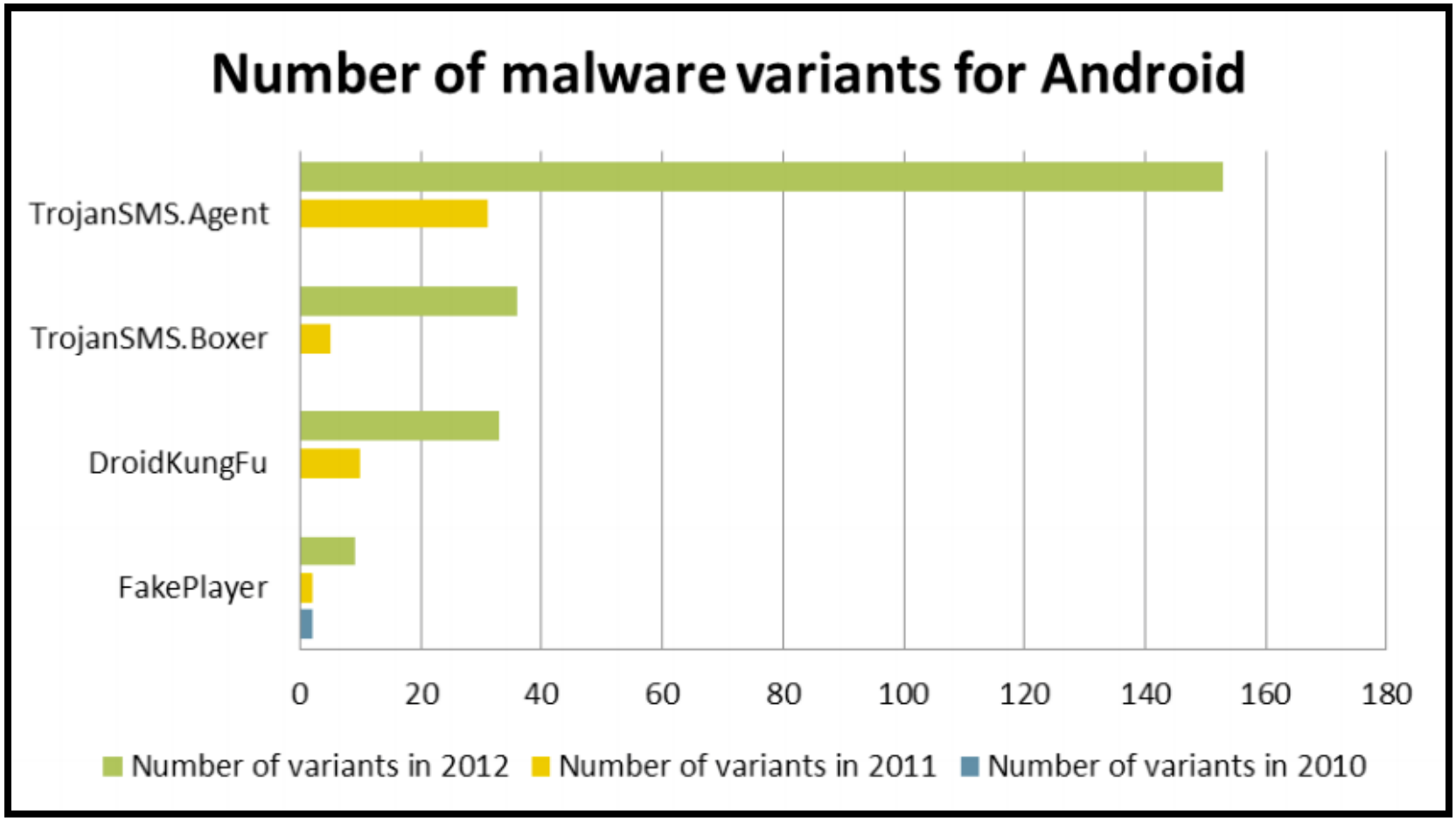
- Cannot observe running processes
- Workarounds:
  - Signature-based matching
  - Custom kernel (e.g., intercept syscalls)
  - Root the device and increase the antimalware's privileges

Malware Limitations

- Classic malware approaches do not apply
- Example: Memory errors cannot be exploited
- Workarounds:
  - Social engineering
  - Phishing
  - Signature evasion

Evading Signatures

repackaging, obfuscation, encryption



http://go.eset.com/us/resources/white-papers/Trends_for_2013_preview

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Antimalware Products

- We count about 100 (free) antimalware products
- They are all based on *signature matching*
- Some provide extras if granted root privileges

How to measure their effectiveness?

1. Obtain **M** samples of known malware
2. Apply **T** transformations to each sample
3. Analyze with **P** x **V** antimalware products and versions
4. Repeat for each of the **A** Android versions

Numbers

- M = 1,000 (very conservative)
- T = 3 (obfuscation, encryption, repackaging)
- P = 100
- V = 2 (simple example)
- A = 3 (2.3, 4.1, 4.2)

1,000 x 3 x 100 x 2 x 3 = 1,800,000 tests

Lack of Automation Tools

VirusTotal.com?

- Relies on command-line, desktop-based AVs with signatures for Android
- Unclear whether the same signatures will work on the respective mobile products
- No versioning support

State of the Art

- H. Pilz, *"Building a test environment for Android anti-malware tests,"* Virus Bulletin Conference '12
  - Human oracle is needed
- M. Zheng, P. P. C. Lee, and J. C. S. Lui, *"ADAM: An Automatic and Extensible Platform to Stress Test Android Anti-Virus Systems,"* DIMVA'12
  - Focus on transformation, uses VirusTotal.com
- V. Rastogi, Y. Chen, and X. Jiang, *"DroidChameleon: Evaluating Android Anti-malware against Transformation Attacks,"* AsiaCCS'13
  - Focus on transformation, uses custom scripts

Challenges

- Parallelization is required
- Android antimalware products are UI driven

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- SDK for writing UI tests/scrapers
- Pluggable adapters for each antimalware
- Parametric tests (e.g., version, platform)
- Task queues with distributed workers

Characteristics

- Web frontend for humans
- JSON/REST API for machines
- Pluggable code-transformation modules
- Works on both emulators and physical devices

Scan application (advanced)

Sample File [ ] Browse

Is this sample a malware?
- ( ) Yes
- ( ) No
- ( ) I do not know

Force sample reanalysis [ ]

Are you human?

Antivirus name	Antivirus version	Android platform	Detection method	
Trend Micro, Mobile Security & Antivi	2.6.2	Android 4.1.2	On install	+
AVAST Software, avast! Mobile Security	2.0.3380	Android 4.1.2	On install	✖
AVAST Software, avast! Mobile Security	2.0.3380	Android 4.1.2	On demand	✖
AVAST Software, avast! Mobile Security	2.0.3917	Android 4.1.2	On install	✖

andrototal (beta)

Scan | Results | Admin | Logout

Sample MD5	cbdf63b2e5666799c4b74a8cd15565dd
Sample SHA-1	d9c2bc199769f8e1c817ccd23f1860f5125bdaf6
Sample SHA-256	d11de9bb4d7451ffe7e4b6bd6bab529e7411e3dbe90d468243ef87a5ed98941e
File size	959488 Bytes
First seen on	08 May 2013
Malicious labels	(Android:FakeInst-EO [PUP]). AndroidOS_FakeInst.VTD not a virus Adware.Startapp.origin.5
Package name	com.issghai.thattere
File names	com.issghai.thattere.apk
External analysis	[VirusTotal] [SandDroid]

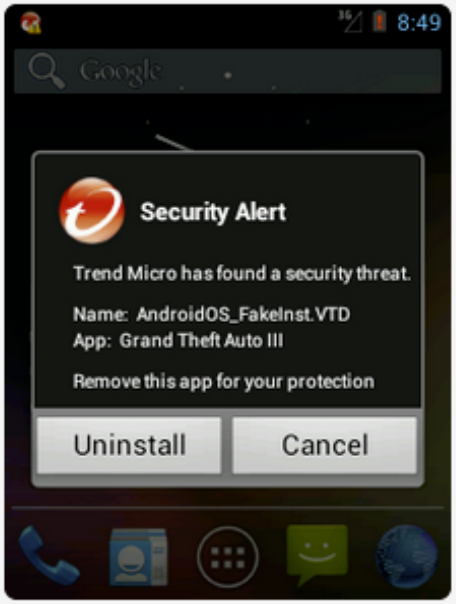
Last 10 scans performed on this sample View all »

Platform	Antivirus Name	Detected name	Date	Results
Android 4.1.2	Doctor Web, Ltd, Dr.Web Anti-virus Light (free) 7.00.3	not a virus Adware.Startapp.origin.5	08/05/13	Full report »
Android 4.1.2	Trend Micro, Mobile Security & Antivirus 2.6.2	AndroidOS_FakeInst.VTD	08/05/13	Full report »
Android 4.1.2	AVAST Software, avast! Mobile Security 2.0.3917	(Android:FakeInst-EO [PUP]).	08/05/13	Full report »
Android 4.1.2	Kaspersky Lab, Kaspersky Mobile Security Lite 9.36.28	No threat detected	08/05/13	Full report »
Android 4.1.2	NortonMobile, Norton Security & Antivirus 3.3.4.970	No threat detected	08/05/13	Full report »

Trend Micro / Mobile Security & Antivirus / 2.6.2 / 2013-05-08 17:07:23 - cbdf63b2e5666799c4b74a8cd15565dd

Mobile Security & Antivirus 2.6.2 scan for cbdf63b2e5666799c4b74a8cd15565dd

Task id	131bd4fe-3bcd-4a72-a207-683ed8eb79f1
Vendor name	Trend Micro
Antivirus name	Mobile Security & Antivirus
Engine version	2.6.2
Analysis started on	08/05/2013 at 17:05
Analysis completed on	08/05/2013 at 17:07 (took *91* seconds)
Detection method	On install
Analysis result	AndroidOS_FakeInst.VTD
Sample md5	cbdf63b2e5666799c4b74a8cd15565dd



Logcat dump (download)

```
99.  I/tmms-vsapi-jni(  674): VSReadVirusPattern OK. Action successful.
100. I/tmms-vsapi-jni(  674): OK. VSSetProcessAllFileInArcFlag. oldValue = ret = 0.
101. I/tmms-vsapi-jni(  674): OK. VSSetExpandLiteFlag. oldValue = ret = 1.
102. I/tmms-vsapi-jni(  674): OK. VSSetProcessAllFileFlag. oldValue = ret = 0.
103. I/tmms-vsapi-jni(  674): OK. VSSetCleanZipFlag. oldValue = ret = 0.
104. I/tmms-vsapi-jni(  674): OK. VSSetCleanBackupFlag. oldValue = ret = 0.
105. I/tmms-vsapi-jni(  674): VSGetDetectableVirusNumber virus in patter num = 3283
106. I/tmms-vsapi-jni(  674): filename = /data/data/com.trendmicro.tmmspersonal/Library/pattern/msvpnaos.457
107. I/tmms-vsapi-jni(  674): InternalVer = 145700, PtnVer = 457.
108. D/PrepareVSAPI4RTScan(  674): before tmmsAntiMalwareJni4RTScan.init()!
109. I/tmms-vsapi-jni(  674): VSInit OK!
110. D/PrepareVSAPI4RTScan(  674): after tmmsAntiMalwareJni4RTScan.init()!
111. I/tmms-vsapi-jni(  674): in vsSetPatternPath, vc = 711579352
112. I/tmms-vsapi-jni(  674): Current pattern path is : /etc/iscan
113. I/tmms-vsapi-jni(  674): Pattern path is set to : /data/data/com.trendmicro.tmmspersonal/Library/pattern
114. I/tmms-vsapi-jni(  674): Pattern file(s) successfully deleted.
115. I/tmms-vsapi-jni(  674): in vsLoadPattern, vc = 711579352, sharedVC = 708085592, scanType =
116. I/tmms-vsapi-jni(  674): vsLoadPattern patternPath = /data/data/com.trendmicro.tmmspersonal/Library/pattern.
```

Writing tests ~~is~~ was tedious

We have abstracted away the low level details, so that we can focus on the important things: *extracting the results*.

Test Recipe (on-install detection)

```
#andrototal-adapters/ComZonerAndroidAntivirus.py
class TestSuite(base.BaseTestSuite):
  def on_install_detection(self, sample_path):
    self.pilot.install_package(sample_path)

    if self.pilot.wait_for_activity(
        "com.zoner.android.antivirus_common.ActScanResults", 10):

      result = self.pilot.get_view_by_id("scaninfected_row_virus")
    else:
      result = False
```

Test Recipe (on-demand detection)

```
#...
def on_demand_detection(self, sample_path):
  self.pilot.install_package(sample_path)
  self.pilot.start_activity("com.zoner.android.antivirus", ".ActMain")
  self.pilot.wait_for_activity("com.zoner.android.antivirus.ActMain")

  self.pilot.tap_on_coordinates(120, 130)
  self.pilot.wait_for_activity("com.zoner.android.antivirus.ActMalware")

  # start scan
  self.pilot.tap_on_coordinates(120, 80)
  self.pilot.wait_for_activity(
    "com.zoner.android.antivirus_common.ActScanResults")

  self.pilot.refre dsh()
# ...
```

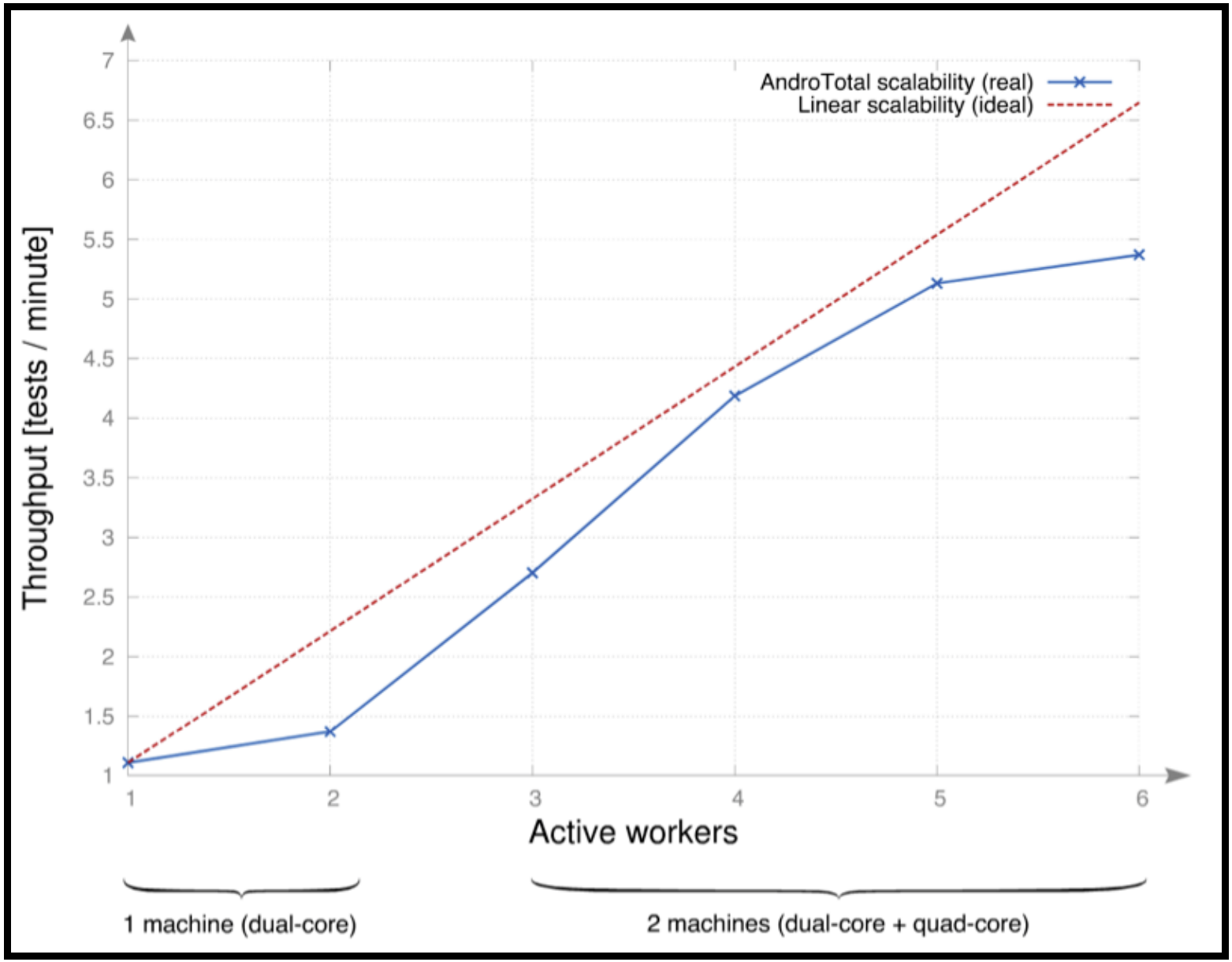
Workflow

1. Retrieve a suspicious APK
2. Choose parameters
   - Android version(s)
   - List of antimalware product and versions
3. Pull clean image(s) from repository
4. Instantiate one test per combination of
   - Android version
   - Product version
5. Enqueue test instances

Architecture

- Web frontend
- Repository of clean Android images
- Asynchronous task dispatcher
- Distributed workers

Scalability



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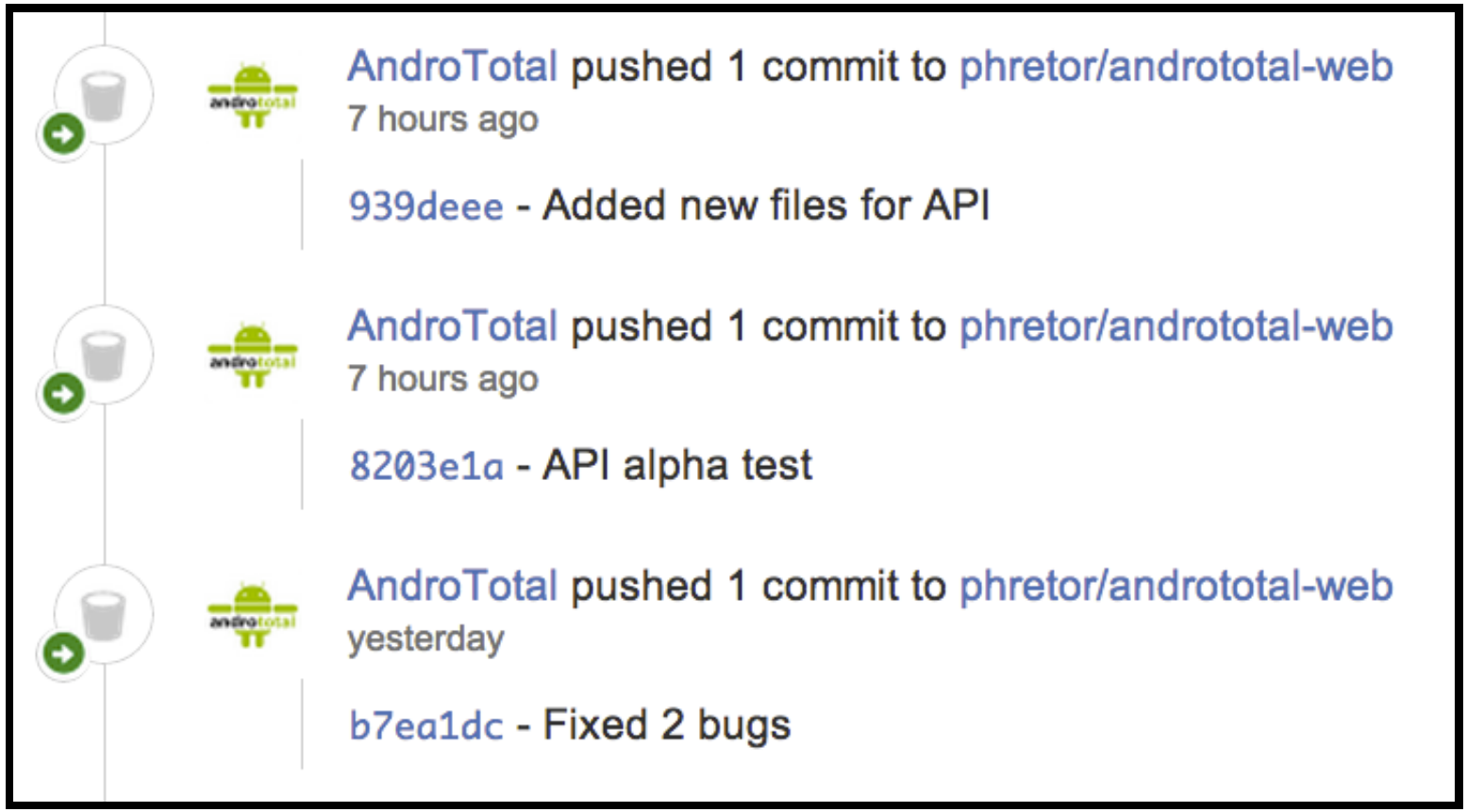
Numbers

- 455 users subscribed in less than a month
- 13 antimalware vendors supported (not all public)
- 16 products overall (not all public)
- 1,465 distinct samples submitted so far

Future Work

- Write a paper :)
- Compare labels and detection results with VirusTotal.com
- Incorporate code-mutation modules
- Add more cores and scale
- ~~Finish the API (only sample sharing is supported as of now)~~
- Deploy on ARM boards and monitor power consumption

7 hours ago...


AndroTotal pushed 1 commit to phretor/andrototal-web
7 hours ago
939deee - Added new files for API
AndroTotal pushed 1 commit to phretor/andrototal-web
7 hours ago
8203e1a - API alpha test
AndroTotal pushed 1 commit to phretor/andrototal-web
yesterday
b7ea1dc - Fixed 2 bugs

Other Ongoing Work on Android Malware Analysis

- PLASMA - Android framework instrumented for malware dynamic analysis
- PuppetDroid - increasing code coverage of "corner cases" in dynamic analysis through semi-automatic UI stimulation
- MoBucket (Mobile Malware Bucket) - consolidated dataset of mobile malware

Thank you!

Questions?

Try it now at **andrototal.org**!

fede@maggi.cc

Extra Slides

Android Popularity