Android Security Extensions

- SSL Usability
- Taint tracking
- Extensible Security
- Inlined Reference Monitoring

http://www.wired.com/images_blogs/gadgetlab/2011/12/new-prof.png

Overview Selected Security Extensions and Tools

CISPA Center for IT-Security, Privacy and Accountability

Malware Detection

Kirin
[Enck et al., ACM CCS 2009]

Apex
[Naumann et al., AsiaCCS 2010]

Paranoid
[Portokalidis et al., ACSAC 2010]

Airmid
[Nadji et al., ACSAC 2011]

DroidScope
[Yan et al., USENIX Sec. 2012]

In-App Ad Library Malware

AdRisk
[Grace et al., WISec 2012]

AdDroid
[Pearce et al., AsiaCCS 2012]

AdSplit
[Dietz et al., USENIX Sec. 2012]

Privilege Escalation (Application-Level)

Confused Deputy

- **IPC Inspection**
  [Felt et al., USENIX Sec. 2012]
- **QUIRE**
  [Dietz et al., USENIX Sec. 2012]
- **XManDroid**
  [Bugiel et al., NDSS 2012]
- **SORBET**
  [Fragkaki et al., TR 2012]

Colluding Apps

- **XManDroid**
  [Bugiel et al., NDSS 2012]

Privilege Escalation (Multi-Level)

FlaskDroid
[Bugiel et al., USENIX Sec. 2013]

SE Android
[Smalley and Craig, NDSS 2013]

ASM
[Heuser et al., USENIX Sec. 2014]

ASF
[Backes et al., ACSAC 2014]

Overview Selected Security Extensions and Tools

CISPA Center for IT-Security, Privacy and Accountability

Detecting and Preventing Private Data Leakage

TaintDroid
[Enck et al., USENIX OSDI 2010]

TISSA
[Zhou et al., TRUST 2011]

AppFence
[Hornyack et al., ACM CCS 2011]

Application Hardening and Context-Based Policies

System extension

- **SAINT**
  [Ongtang et al., ACSAC 2009]
- **CRePE**
  [Conti et al., ISC 2010]

Inlined Reference Monitor

- **Aurasium**
  [Xu et al., USENIX Sec. 2012]
- **AppGuard**
  [Backes et al., DPM 2013]
- **Dr Android and Mr. Hide** [Jeon et al., SPSM 2012]

DRM Policies and Domain Isolation

Porscha
[Ongtang et al., ACSAC 2010]

MOSES
[Russello et al., SACMAT 2012]

TrustDroid
[Bugiel et al., ACM SPSM 2011]

Security Aspects of App Stores

DroidRanger
[Zhou et al., NDSS 2012]

DroidMOSS
[Zhou et al., CODASPY 2012]

Meteor
[Barrera et al., IEEE MoST 2012]

Android Security Extensions

SSL Usability [33,35]

DC Sec

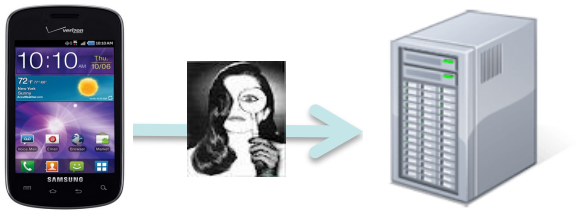
Leibniz Universität Hannover

Rethinking SSL Development in an Appified World

Sascha Fahl
Marian Harbach
Henning Perl
Markus Kötter
Matthew Smith

Manual App Testing Results

- cherry-picked 100 Apps
- 21 Apps trust all certificates
- 20 Apps accept all hostnames



What we found:

Talking to Developers

- Finding broken SSL in Apps is good…
  - …knowing what the root causes are is even better
- We contacted 80 developers of broken apps
  - informed them
  - offered further assistance
  - asked them for an interview
- 15 developers agreed

Common: Blaming Developers

"It's all the developers' fault!"

It’s Time to Rethink how we code SSL

Developers' Wishlist

- Self-Signed Certificates – Development
- Self-Signed Certificates – Production
- Less SSL Coding
- Certificate Pinning / Trusted Roots
- Easy-to-use Warning Message

Getting out of the Dilemma

Current Situation:

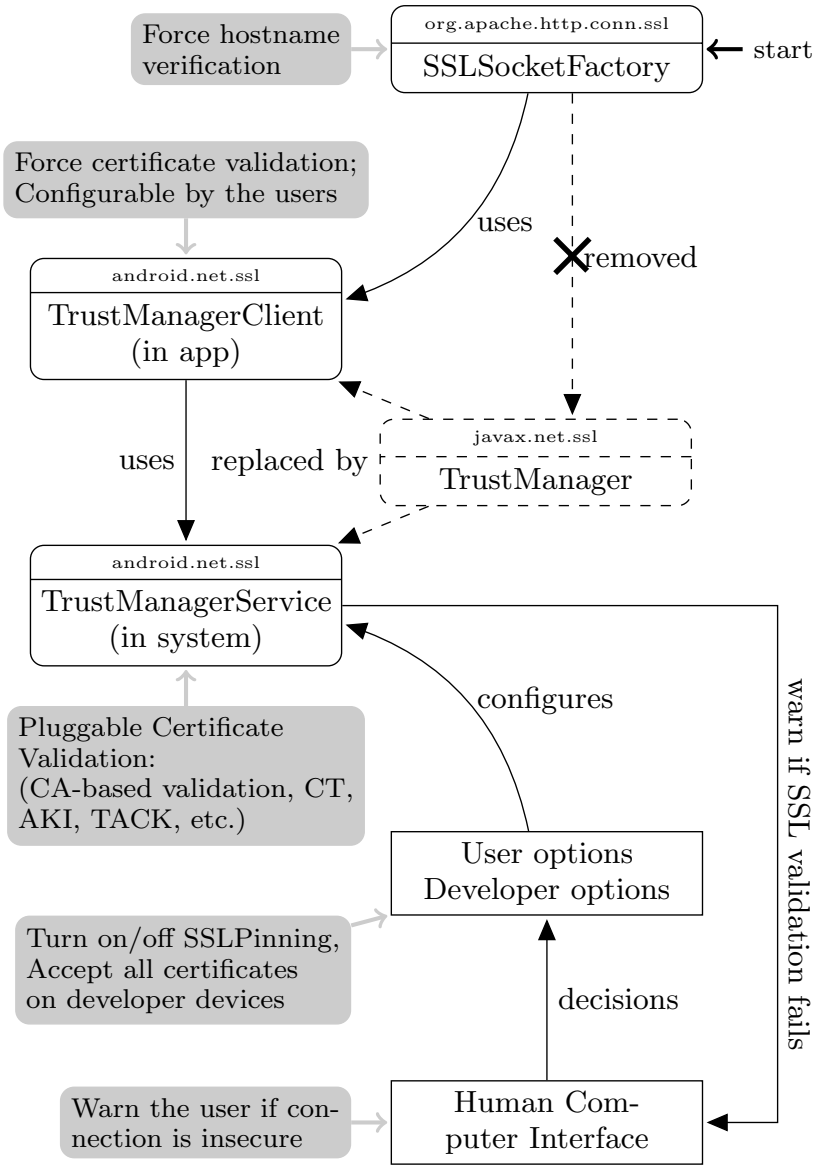
- Developers have the freedom to customize certificate validation
- Developers mostly are not security experts
- Developers find the current situation too inflexible

Future Situation:

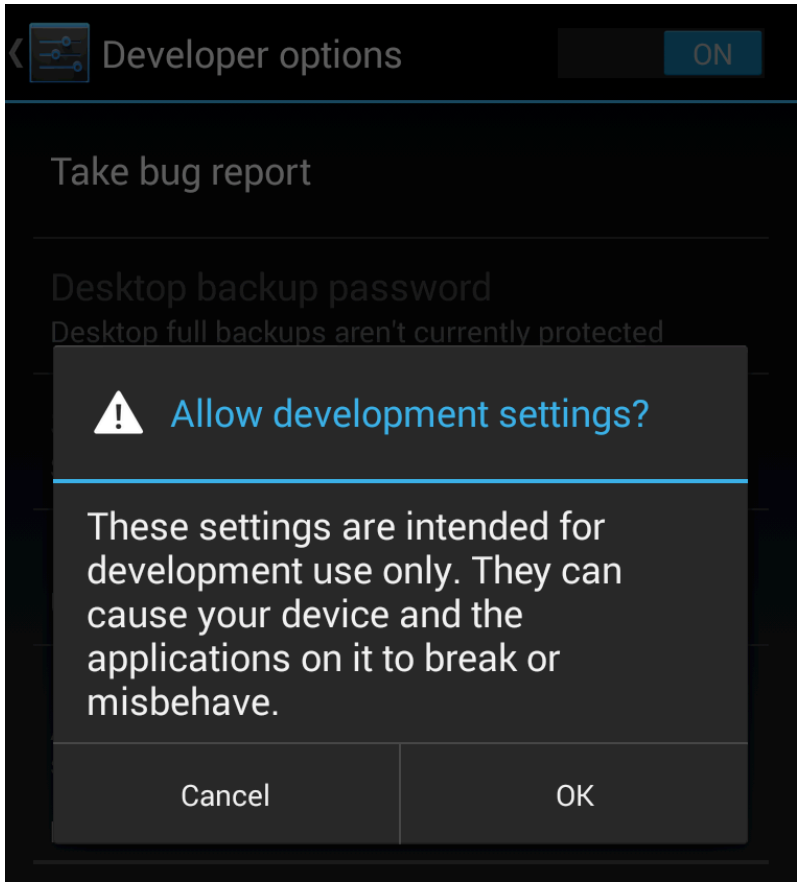
- Protect the user!
- Make the common use cases easy
- Adapt certificate handling to the developers' needs

Solution: Improve usability of certificate handling for developers!

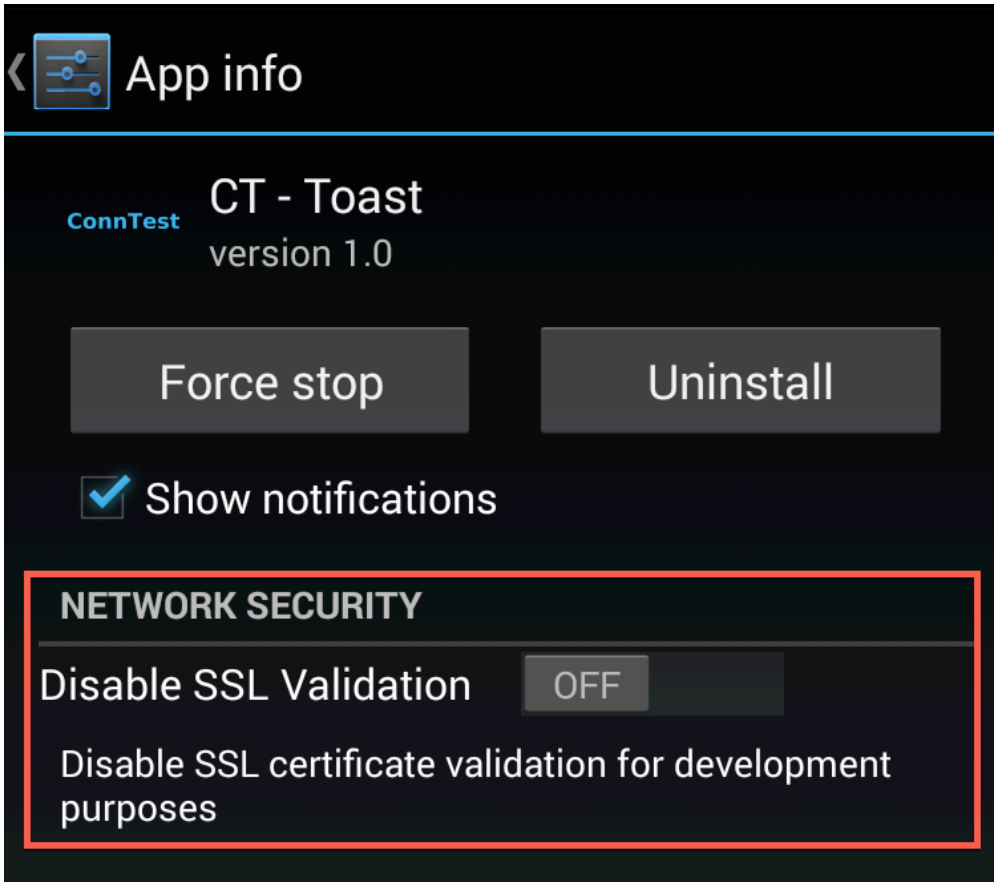
Patching Android OS



Self-Signed Certificates – Development



enable developer options



disable SSL validation for this app only

Certificate Pinning / Trusted Issuers

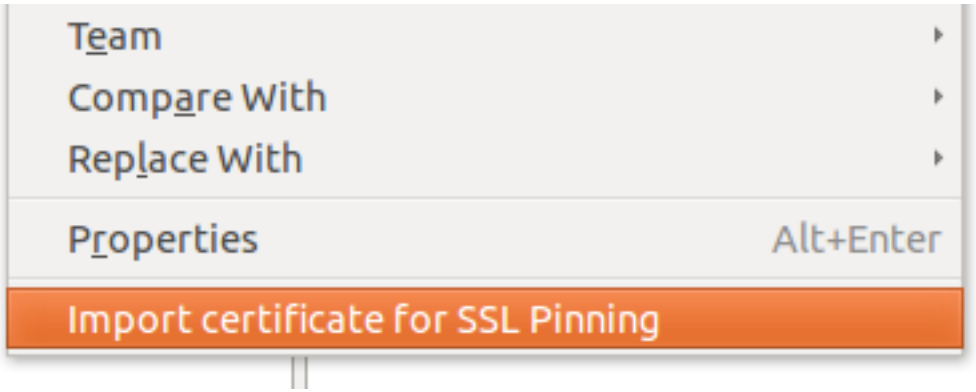
This is easy!

```
<uses-ssl>
    <pins host="securessl.com">
        <pin type="ca" comment="Verisign Root CA">
            8F:57:5A:C8:5B:09:63:B0:24:2B:90...
        </pin>
        <pin type="cert" comment="Self-Signed">
            18:DA:D1:9E:26:7D:E8:BB:4A:21:58...
        </pin>
    </pins>
</uses-ssl>
```

Certificate Pinning / Trusted Issuers (2)

This is easier!

```
URL url = new URL("https://www.dcsec.uni-hannover.de");
HttpsURLConnection conn = (HttpsURLConnection) url.openConnection();
conn.setReadTimeout(10000 /* milliseconds */);
conn.setConnectTimeout(15000 /* milliseconds */);
conn.setRequestMethod("GET");
conn.setDoInput(true);
```



Conclusion

- ✔ Eve and Mallory no longer love Android
- ✔ Backwards compatible – no broken apps, except
  - ✘ apps that implemented pinning (19 in 13500 tested Android apps)
  - ✔ updating them to the new pinning sytem is very easy
- ✔ New features for Android
  - ✔ Easy to use self-signed certs for development
  - ✔ Easy to use pinning / custom CAs
  - ✔ Central and easy to use warning messages
  - ✔ Central place to plug in new validation strategies – such as CT, TACK, etc
- ✔ Contacted developers –
  - ✔ got positive feedback

Download the Code and have a go: http://android-ssl.org

Android Security Extensions

Taint tracking [36,37]

TaintDroid: An Information-Flow Tracking System for Realtime Privacy Monitoring on Smartphones

OSDI'10

William Enck, Peter Gilbert, Byung-Gon Chun, Landon P. Cox, Jaeyeon Jung, Patrick McDaniel, and Anmol N. Sheth

Monitoring Smartphone Behavior

- There are tens of thousands of smartphone apps that provide both fun and valuable utility.
- *General challenge*: balance fun and utility with privacy
- Step 1: "look inside" of applications to watch how they use privacy sensitive data
  - location
  - phone identifiers
  - microphone
  - camera
  - address book

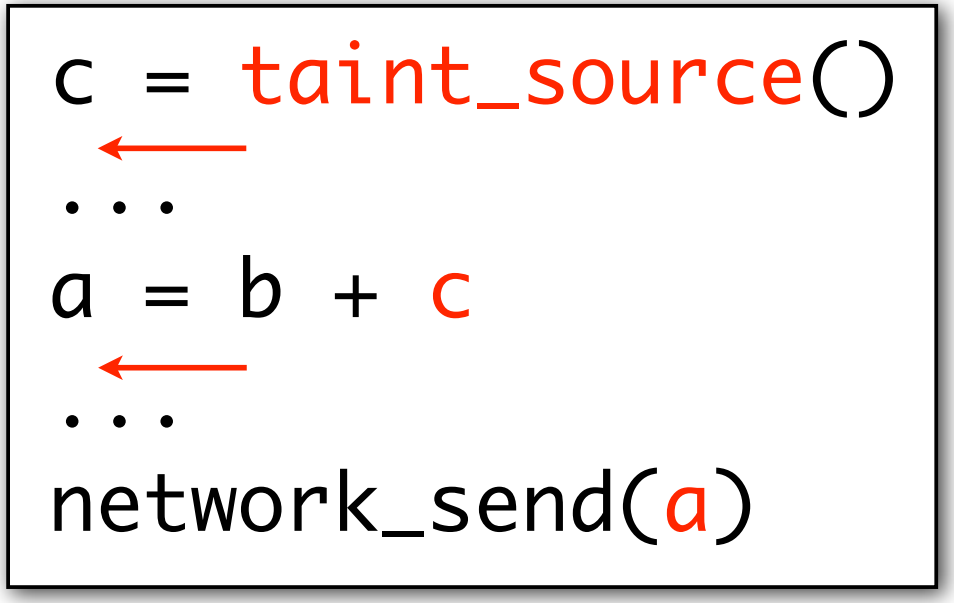
Challenges

- *Goal*: Monitor app behavior to determine when privacy sensitive information leaves the phone

- *Challenges ...*
  - *Smartphones are resource constrained*
  - *Third-party applications are entrusted with several types of privacy sensitive information*
  - *Context-based privacy information is dynamic and can be difficult to identify even when sent in the clear*
  - *Applications can share information*

Dynamic Taint Analysis

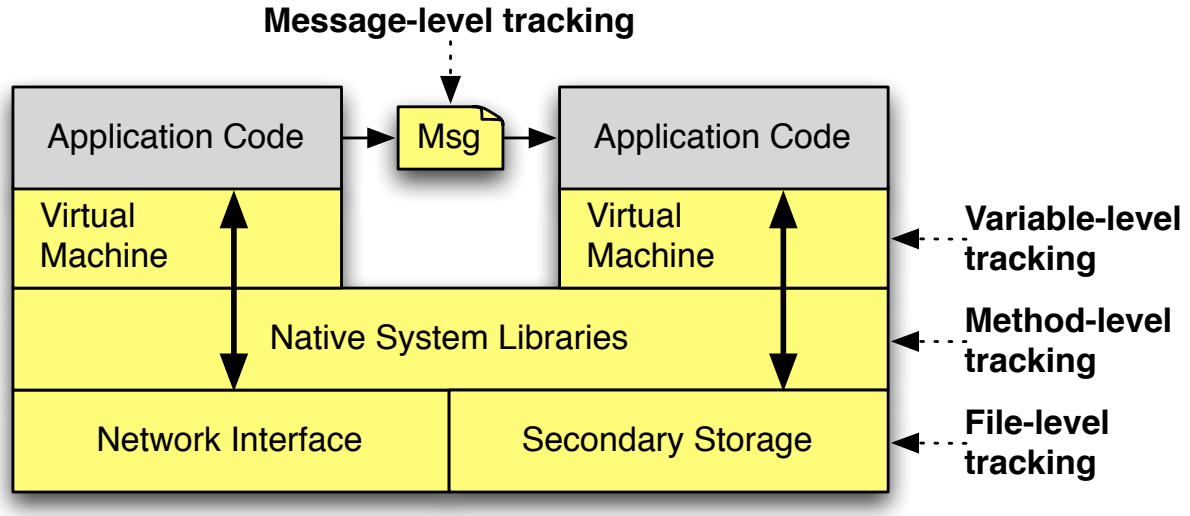
- Dynamic taint analysis is a technique that tracks information dependencies from an origin
- Conceptual idea:
  - Taint source
  - Taint propagation
  - Taint sink



- *Limitations*: performance and granularity is a trade-off

TaintDroid

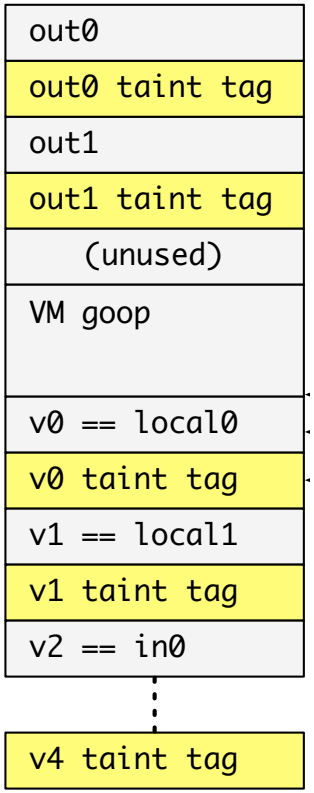
- TaintDroid is a system-wide integration of taint tracking into the Android platform
  - Variable tracking throughout Dalvik VM environment
  - Patches state after native method invocation
  - Extends tracking between applications and to storage



- *TaintDroid is a firmware modification, not an app*

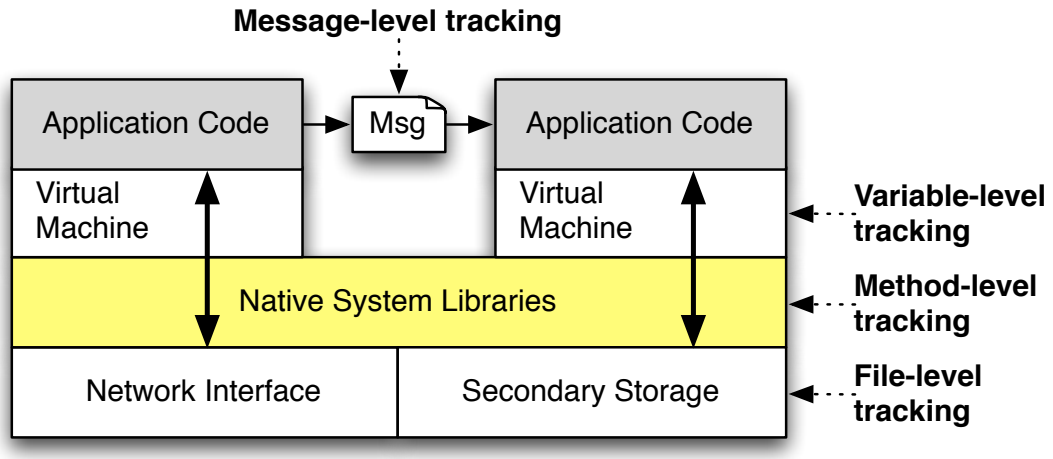
VM Variable-level Tracking

- We modified the Dalvik VM interpreter to *store* and *propagate* taint tags (a taint bit-vector) on variables.
- *Local variables and args*: taint tags stored adjacent to variables on the internal execution stack.
  - 64-bit variables span 32-bit storage
- *Class fields*: similar to locals, but inside static and instance field heap objects
- *Arrays*: one taint tag per array to minimize overhead



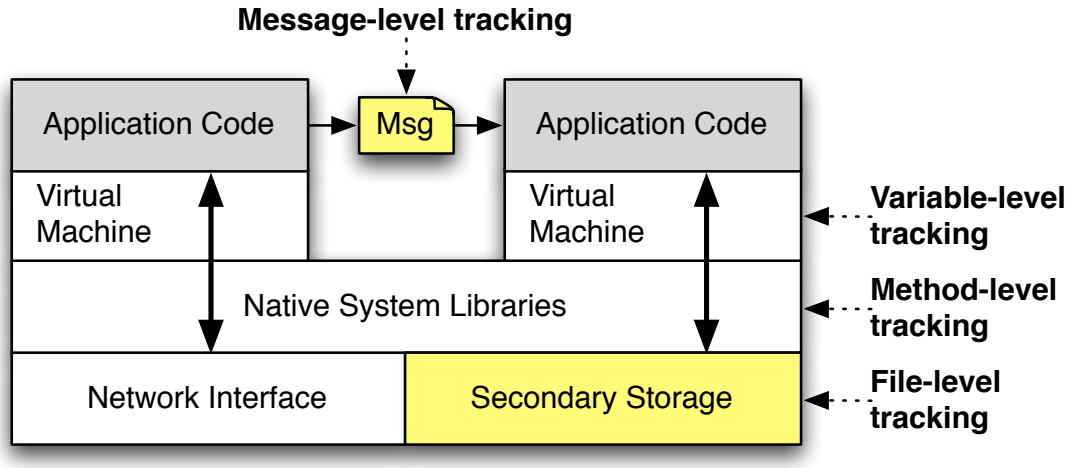
Native Methods

- Applications execute *native methods* through the Java Native Interface (JNI)
- TaintDroid uses a combination of heuristics and *method profiles* to patch VM tracking state
  - Applications are restricted to only invoking native methods in system-provided libraries



IPC and File Propagation

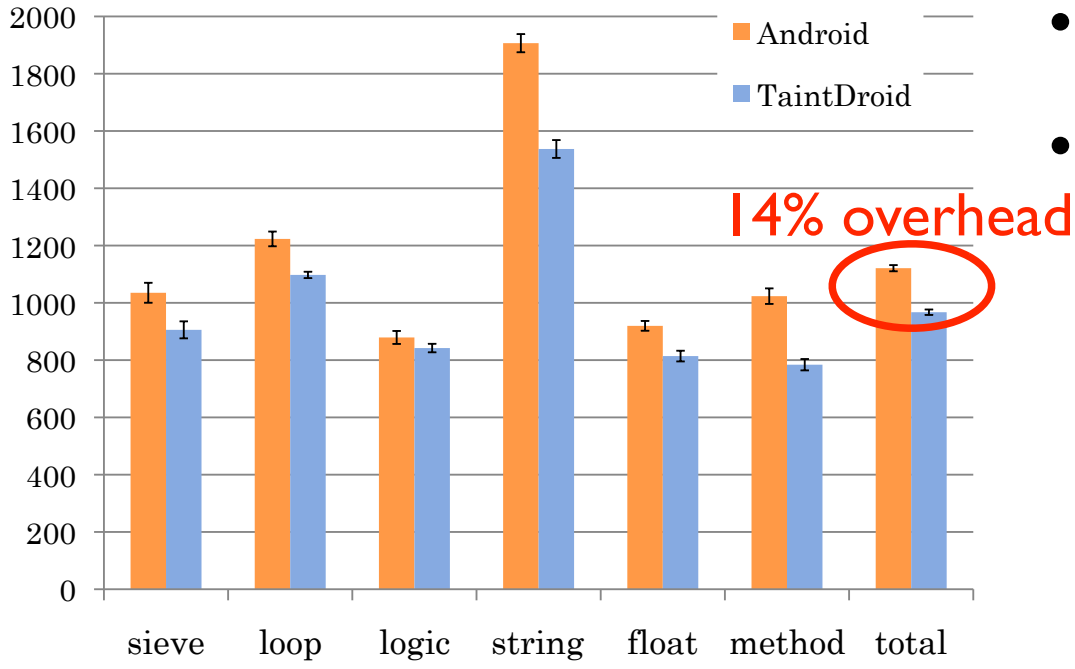
- TaintDroid uses *message level* tracking for IPC
  - Applications marshall and unmarshall individual data items
- Persistent storage tracked at the *file level*
  - Single taint tag stored in the file system XATTR



Performance

CaffeineMark 3.0 benchmark

(higher is better)



CaffeineMark score roughly corresponds to the number of Java instructions per second.

- Memory overhead: 4.4%
- IPC overhead: 27%
- Macro-benchmark:
  - App load: 3% (2ms)
  - Address book: (< 20 ms) 5.5% create, 18% read
  - Phone call: 10% (10ms)
  - Take picture: 29% (0.5s)

Taint Adaptors

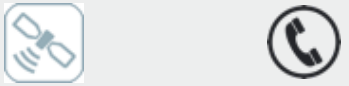
PENNSTATE 1855

- Taint *sources* and *sinks* must be carefully integrated into the existing architectural framework.

- Depends on information properties
  - *Low-bandwidth sensors*: location, accelerometer
  - *High-bandwidth sensors*: microphone, camera
  - *Information databases*: address book, SMS storage
  - *Device identifiers*: IMEI, IMSI*, ICC-ID, Ph. #
  - *Network taint sink*

Application Study

- Selected 30 applications with bias on popularity and access to *Internet*, *location*, *microphone*, and *camera*

applications	#	permissions
The Weather Channel, Cetos, Solitarie, Movies, Babble, Manga Browser	6	
Bump, Wertago, Antivirus, ABC --- Animals, Traffic Jam, Hearts, Blackjack, Horoscope, 3001 Wisdom Quotes Lite, Yellow Pages, Datelefonbuch, Astrid, BBC News Live Stream, Ringtones	14	
Layer, Knocking, Coupons, Trapster, Spongebot Slide, ProBasketBall	6	
MySpace, Barcode Scanner, ixMAT	3	
Evernote	1	

- *Of 105 flagged connections, only 37 clearly legitimate*

Findings - Location

- 15 of the 30 applications shared physical location with an ad server (*admob.com*, *ad.qwapi.com*, *ads.mobclix.com*, *data.flurry.com*)
- Most traffic was plaintext (e.g., AdMob HTTP GET):

```
...&s=a14a4a93f1e4c68&..&t=062A1CB1D476DE85
B717D9195A6722A9&d%5Bcoord%5D=47.661227890000006%2C-122.31589477&...
```

- In no case was sharing obvious to user or in EULA
  - In some cases, periodic and occurred without app use

Findings - Phone Identifiers

- 7 applications sent device (*IMEI*) and 2 apps sent phone info (*Ph. #*, *IMSI**, *ICC-ID*) to a remote server without informing the user.
  - One app's EULA indicated the IMEI was sent
  - Another app sent the hash of the IMEI
- Frequency was app-specific, e.g., one app sent phone information every time the phone booted.
- Appeared to be sent to app developers ...

> "There have been cases in the past on other mobile platforms where well-intentioned developers are simply over-zealous in their data gathering, without having malicious intent." -- Lookout

Limitations

- Approach limitations:
  - TaintDroid only tracks data flows (i.e., explicit flows).
- Taint source limitations:
  - IMSI contains country (MCC) and network (MNC) codes
  - File databases must be all one type

Summary

- TaintDroid provides efficient, system-wide, dynamic taint tracking and analysis for Android
- We found 20 of the 30 studied applications to share information in a way that was not expected.
- Source code will be available soon: *appanalysis.org*
- Future investigations:
  - Provide direct feedback to users
  - Potential for realtime enforcement
  - Integration with expert rating systems

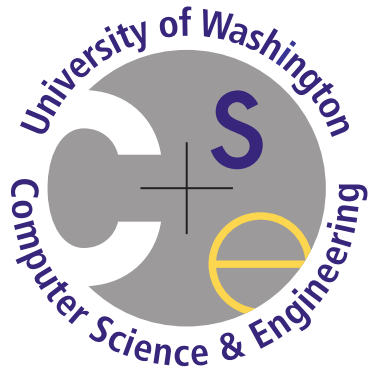
Demo

- Demo available at http://appanalysis.org/demo/

These Aren't the Droids You're Looking For

Retrofitting Android to Protect Data from Imperious Applications

Peter Hornyack, Seungyeop Han, Jaeyeon Jung, Stuart Schechter, David Wetherall



Microsoft® Research

What is “sensitive data”?

* We identified 12 types of privacy-sensitive data on Android

device id
location
phone number
contacts
camera
accounts
logs
microphone
SMS messages
history & bookmarks
calendar
subscribed feeds

How can we tell what apps are doing?

* *TaintDroid*: dynamic taint tracking for Android applications [Enck10]

```
loc = getLocation();        //taint tag applied
...
loc_copy = loc;             //taint propagated
...
network_send(loc_copy);     //checked for taint
```

* Apps can't transform, obfuscate or encrypt data to remove taint
* We enhanced TaintDroid: added tracking for all 12 data types

Gives us runtime detection of sensitive data transmission for *unmodified apps*

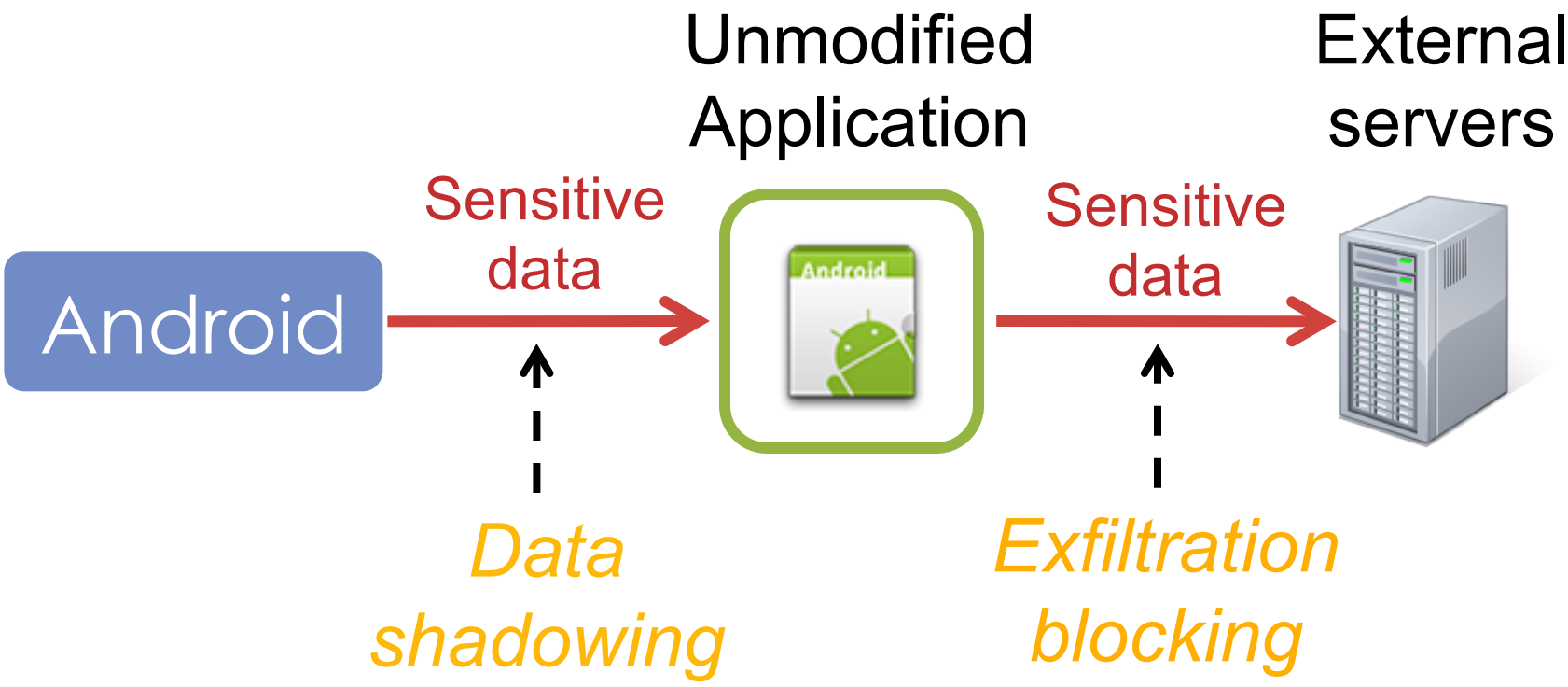
(example taken from William Enck OSDI'10)

How can we defend against these apps?

* Threat: applications may misappropriate users' sensitive data
* We have a tool, TaintDroid, that can monitor unmodified applications at runtime
* Can we do something simple to unmodified applications to defend against this threat?

Our system: *AppFence*

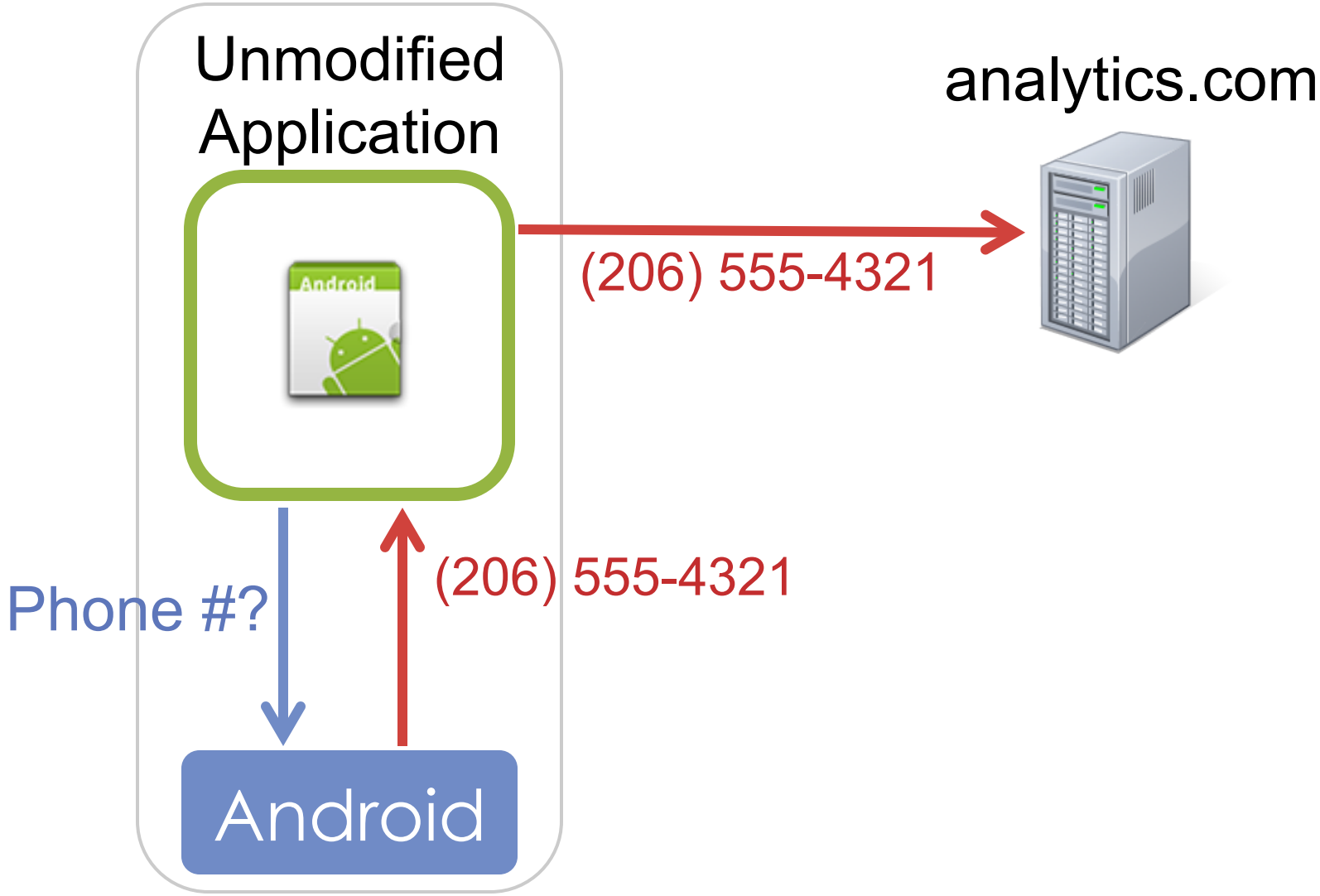
AppFence uses two *privacy controls*



- Two complementary privacy controls:
  - Shadowing: app doesn't get sensitive data at all
  - Blocking: app gets sensitive data, but can't send it out

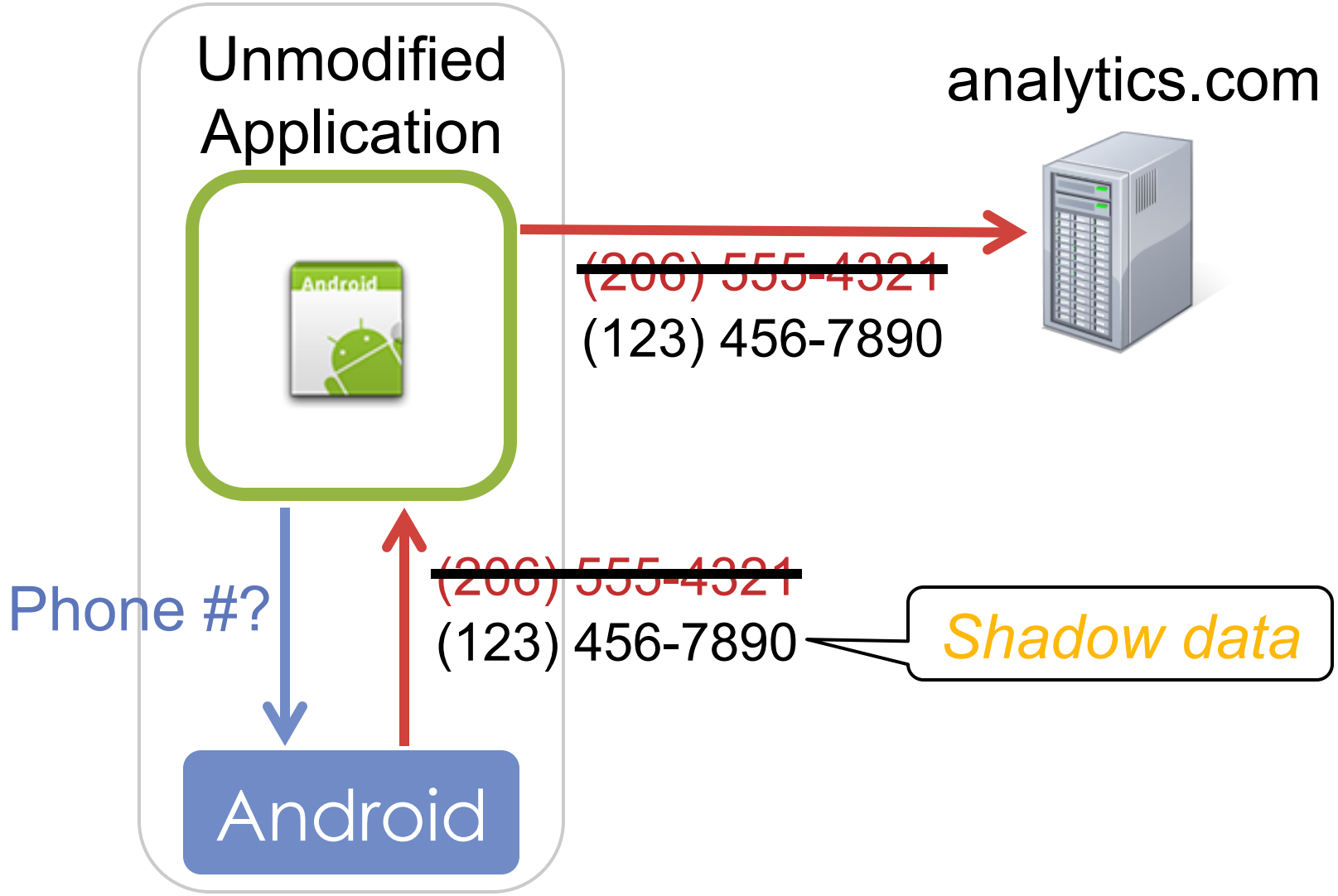
How data shadowing works

Without data shadowing:



How data shadowing works

With data shadowing:

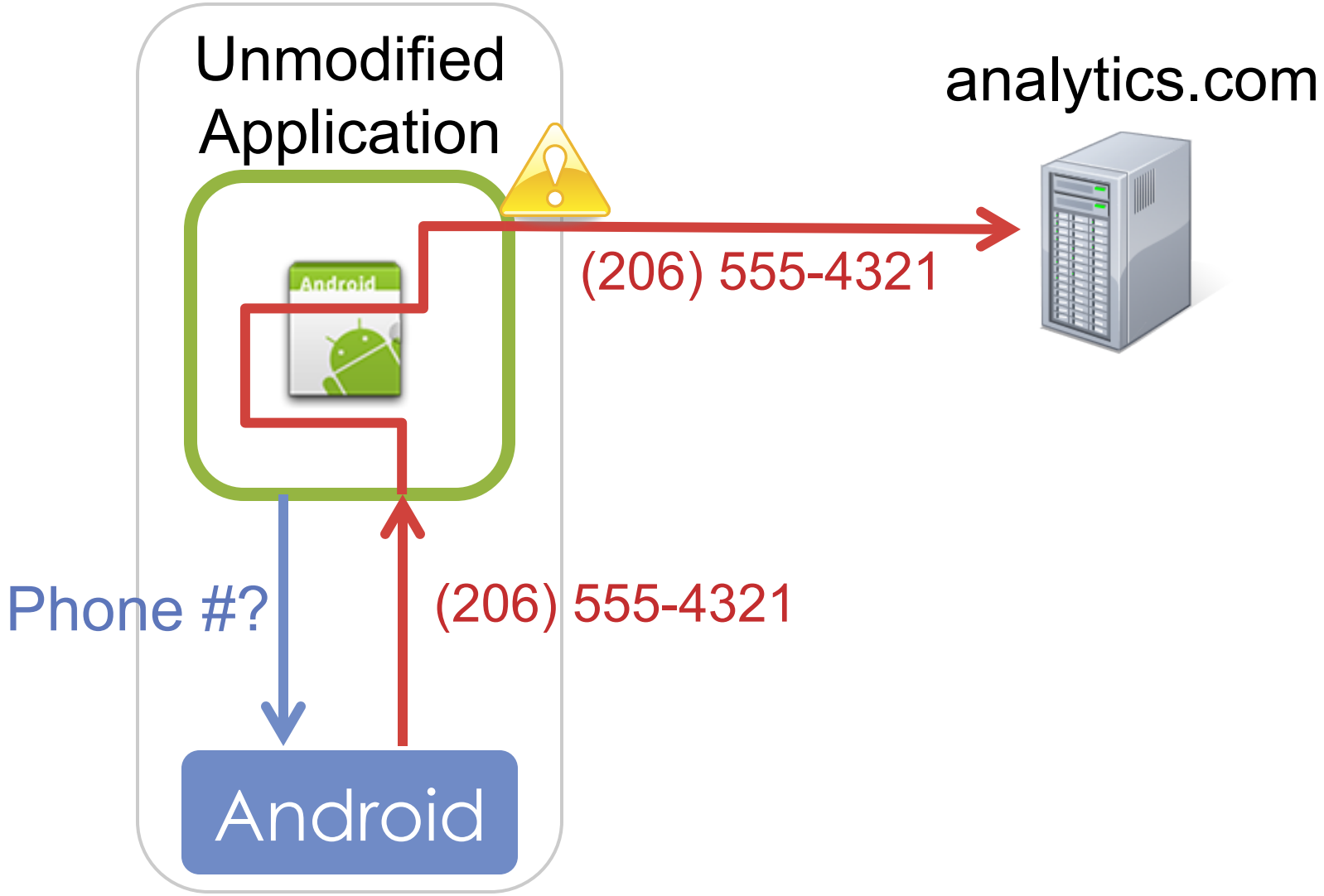


Three kinds of shadow data

- Blank data
  - e.g. contacts: {S. Han, 206-555-4321} ➔ {}
- Fake data
  - e.g. location: {47.653,-122.306} ➔ {41.887,-87.619}
- Constructed data
  - e.g. device ID = *hash*(app name, true device ID)
    - Consistent for each application, but different across applications

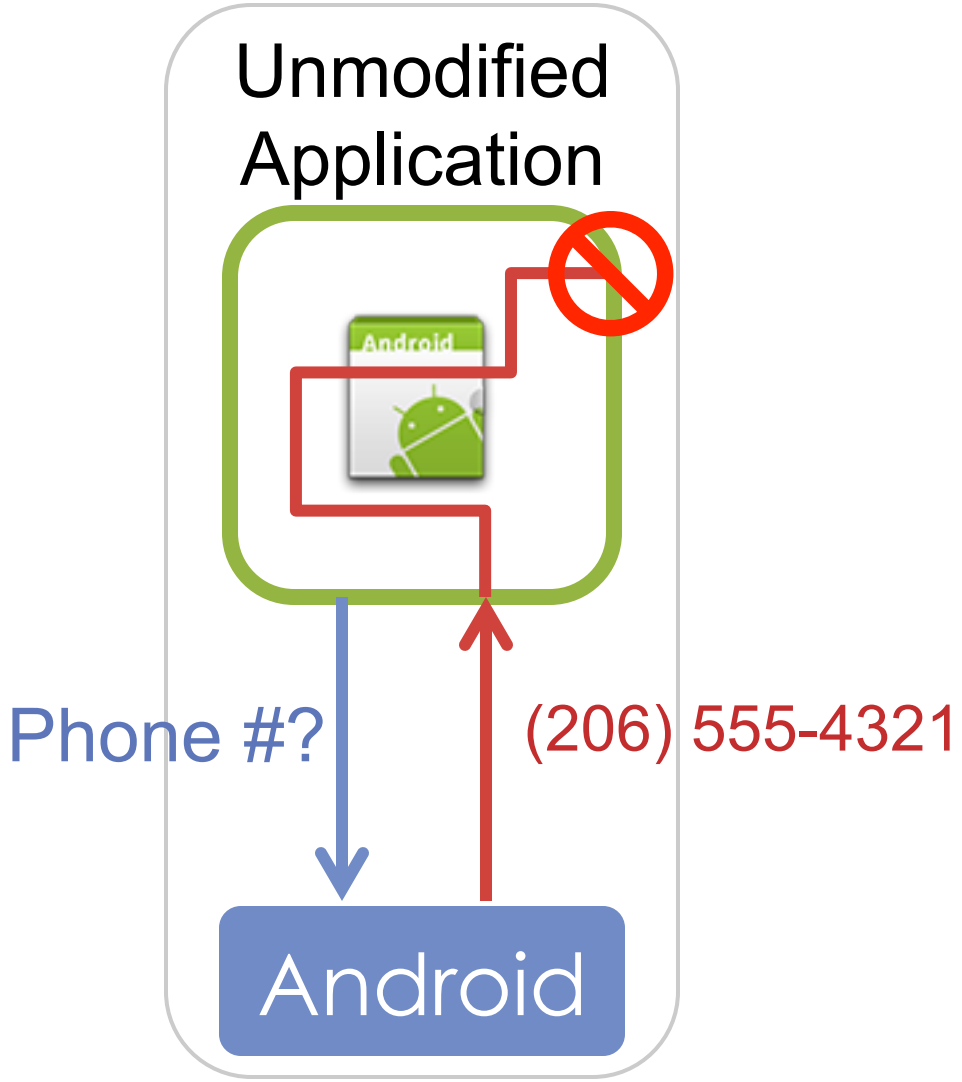
How exfiltration blocking works

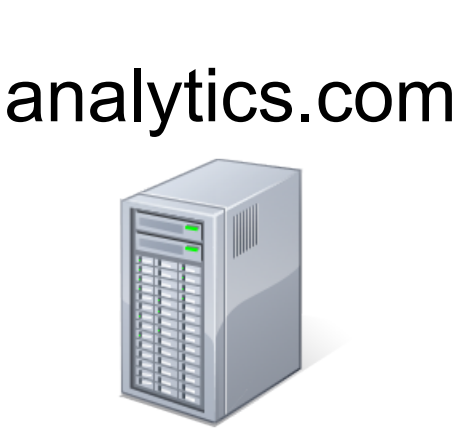
Without exfiltration blocking:



How exfiltration blocking works

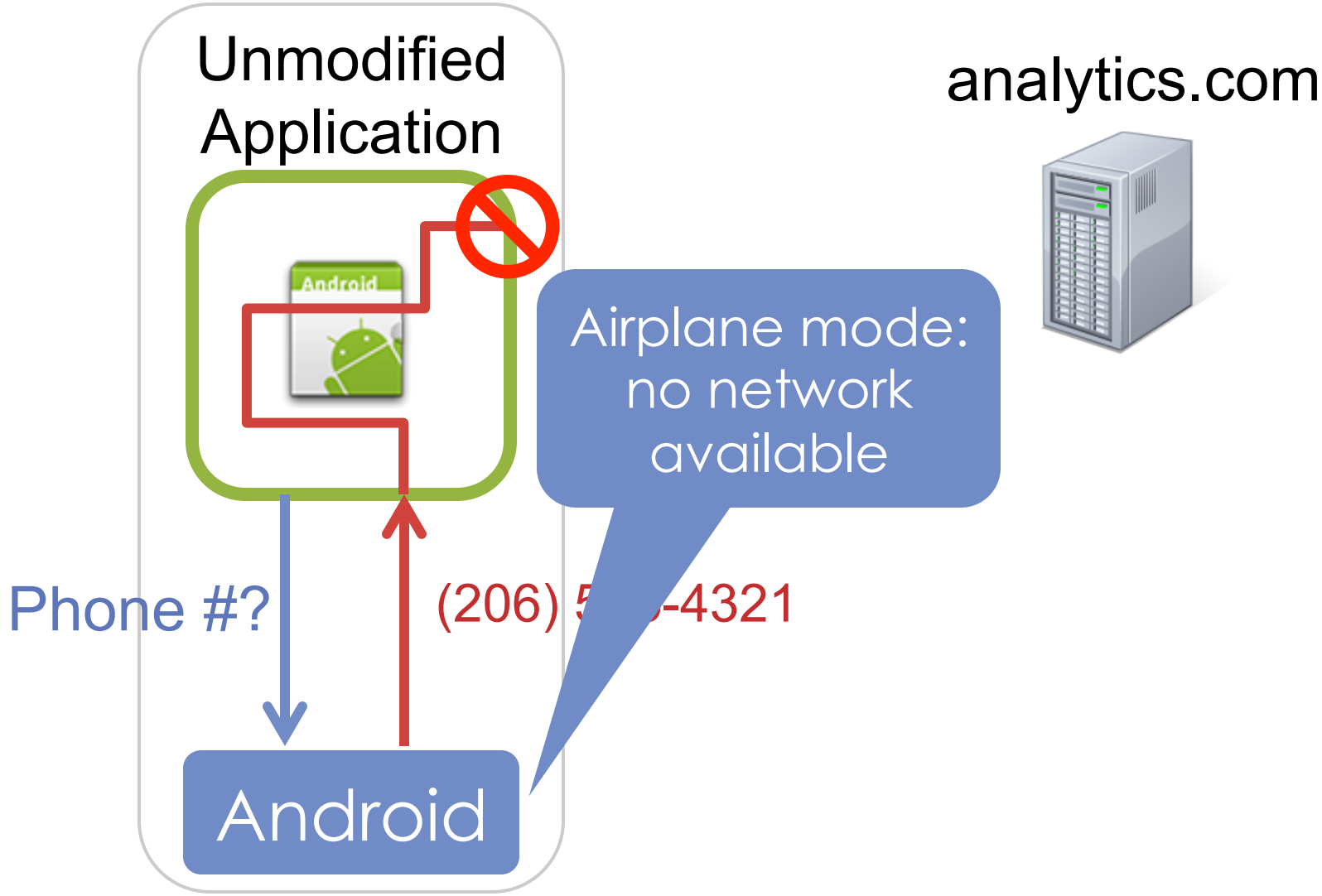
With exfiltration blocking:





How exfiltration blocking works

With exfiltration blocking:



Side effects shown by 50 apps

	Data shadowing	Exfiltration blocking
None	28 (56%)	16 (32%)
Ads absent	0 (0%)	11 (22%)
Less functional	14 (28%)	10 (20%)
Broken	8 (16%)	13 (26%)

* Slightly more than half of the apps ran with limited or no side effects

Side effects shown by 50 apps

	Data shadowing	Exfiltration blocking
None	28 (56%)	16 (32%)
Ads absent	0 (0%)	11 (22%)
Less functional	14 (28%)	10 (20%)
Broken	8 (16%)	13 (26%)

* Slightly more than half of the apps ran with limited or no side effects
* Data shadowing was less disruptive than exfiltration blocking

Side effects shown by 50 apps

	Data shadowing	Exfiltration blocking
None	28 (56%)	16 (32%)
Ads absent	0 (0%)	11 (22%)
Less functional	14 (28%)	10 (20%)
Broken	8 (16%)	13 (26%)

* Remember, we applied a *single* privacy control (one or the other) to *all* applications

Side effects shown by 50 apps

	Data shadowing	Exfiltration blocking	Choose least-disruptive
None	28 (56%)	16 (32%)	30 (60%)
Ads absent	0 (0%)	11 (22%)	3 (6%)
Less functional	14 (28%)	10 (20%)	11 (22%)
Broken	8 (16%)	13 (26%)	6 (12%)

- Choose the control that caused least-severe side effects for each app: 33 apps (66%) had no side effects or ads absent
  - We used profiling to choose; determining in advance is challenging

So 34% of applications didn't work?

* These apps had four kinds of functionality that *directly conflict* with our configuration (sensitive data should never leave the device):
  * Location broadcast (location)
  * Geographic search (location)
  * Find friends (contacts)
  * Cross-application gaming profiles (device ID)

What does this mean for AppFence?

- Some applications force the user to *choose* between functionality and privacy
  - Protecting sensitive data will *always* cause side effects for these applications
- Remaining apps: AppFence can prevent misappropriation without side effects
  - Choosing the least-disruptive privacy control in advance is still an open problem
  - Each control was less disruptive for certain sensitive data types

Conclusion

- AppFence breaks the power of the installation ultimatum
- We revealed side effects by *never* allowing sensitive data to leave the device
- Some apps: user must choose between functionality and privacy
- Majority of apps: two privacy controls can prevent misappropriation without side effects

Android Security Extensions

Extensible Security [39,40]

http://www.wired.com/images_blogs/gadgetlab/2011/12/new-prof.png

ASM: A Programmable Interface for Extending Android Security

Stephan Heuser,

Ahmad-Reza Sadeghi

Intel Collaborative Research Institute for Secure Computing at TU Darmstadt, Germany

Adwait Nadkarni,

William Enck

NC State University, USA

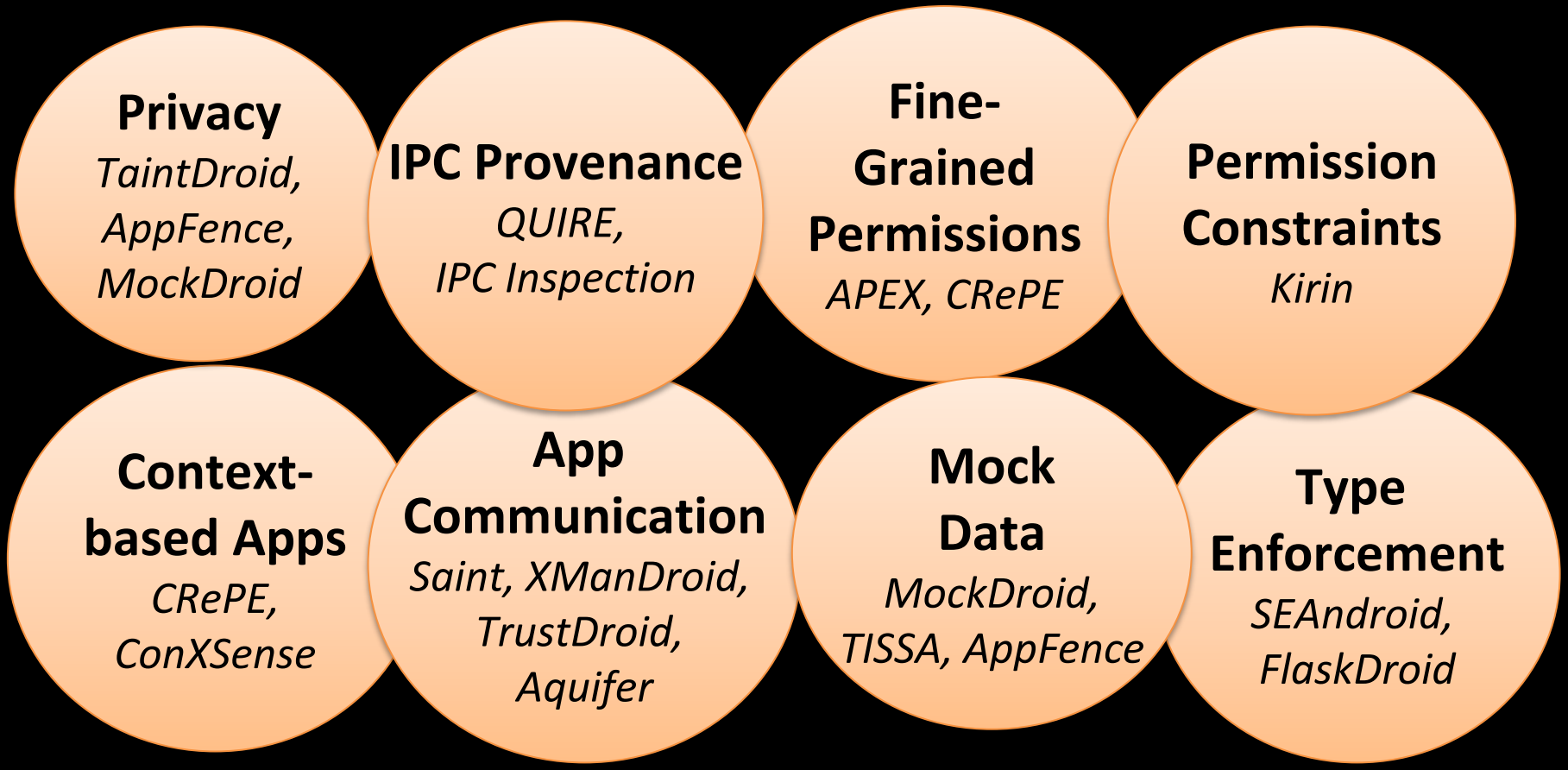
Android Security Framework:
Extensible multi-layered access control on Android

M. Backes, S. Bugiel, S. Gerling, and P. von Styp-Rekowsky

To appear at 30th Annual Computer Security Applications Conference (ACSAC'14)

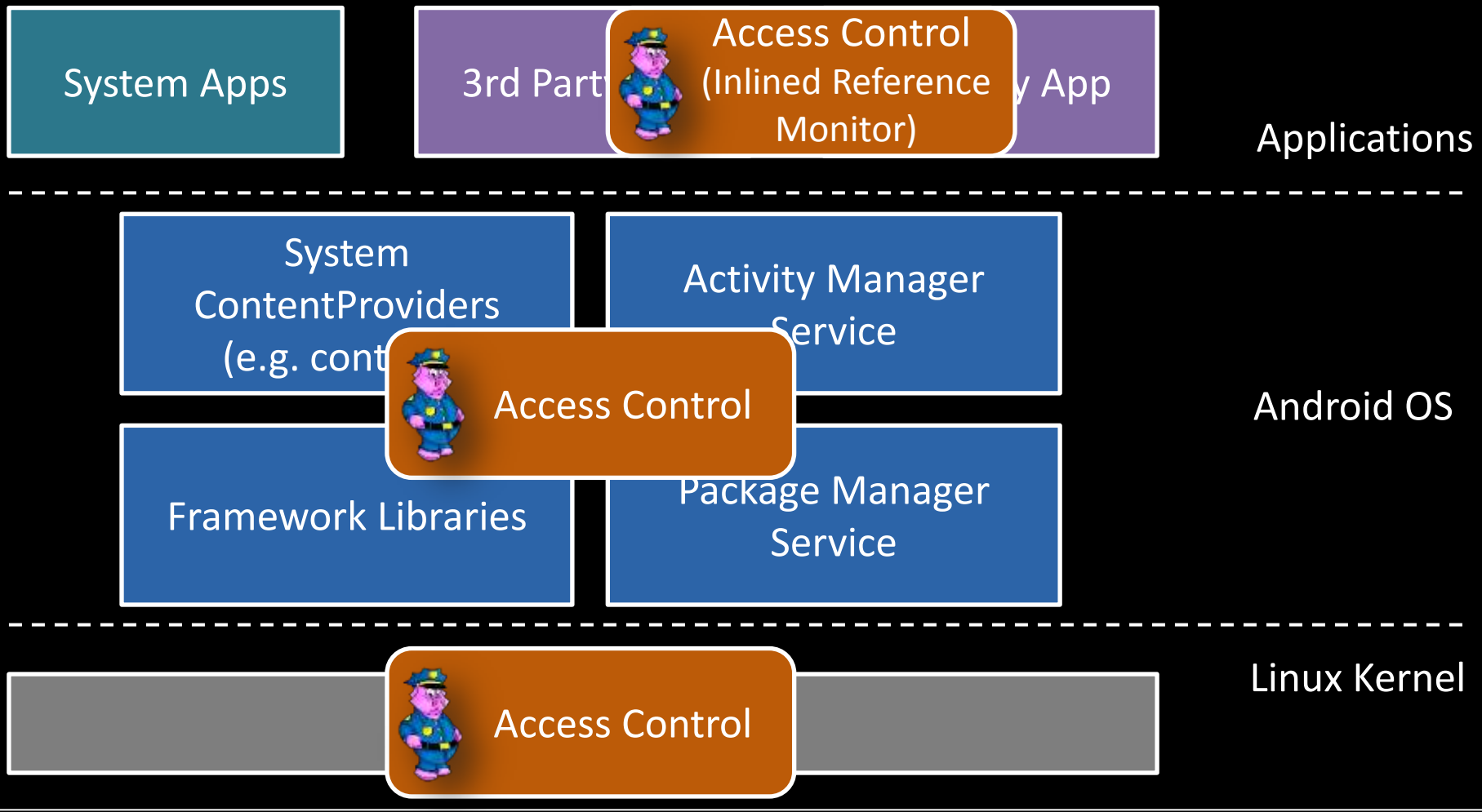
Android Security Extensions (selected)

Security extensions focus on
specific use cases and/or *security and privacy models*



Android Security Extensions

Access control (hooks) are embedded in sensitive components



Research Question

Is it possible to provide a *programmable* and *generic* security architecture on top of which many of these solutions can be instantiated?

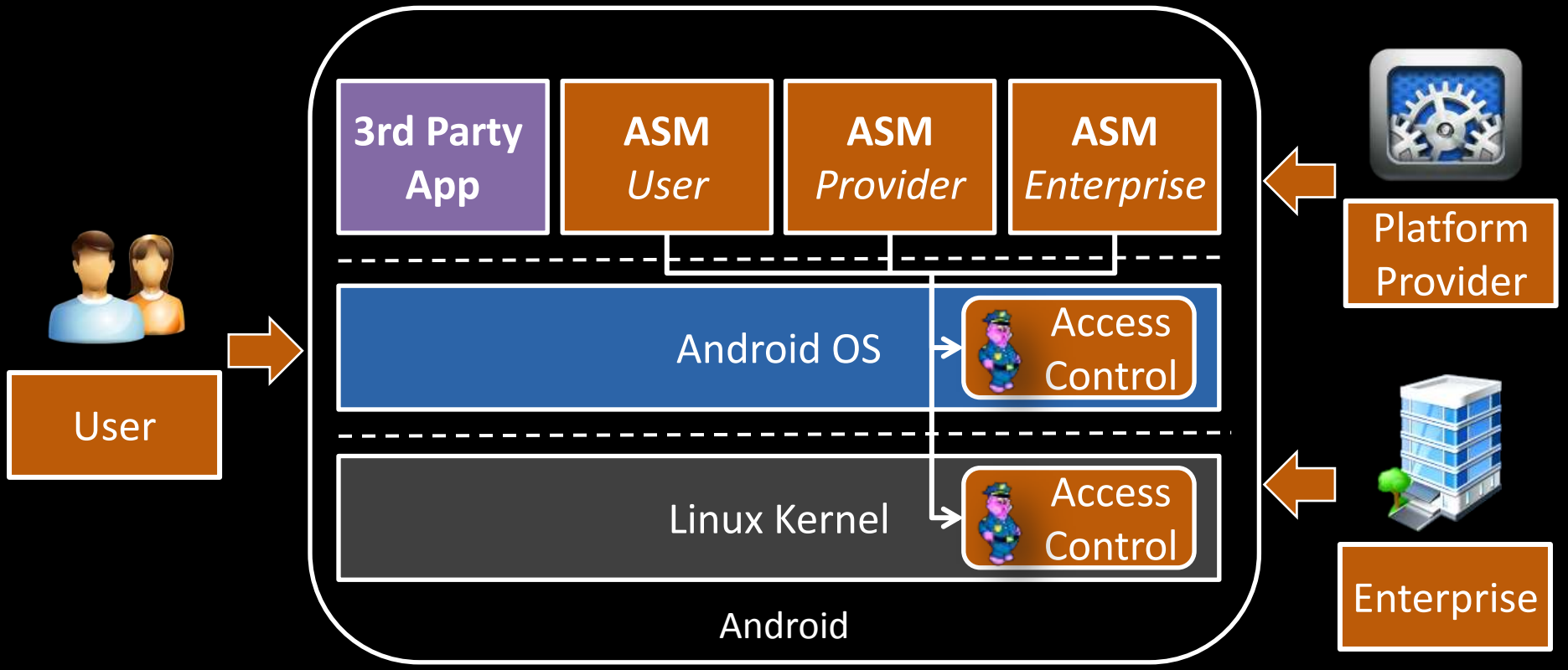
Observations

Diverse Goals, but use similar security hooks and mechanisms

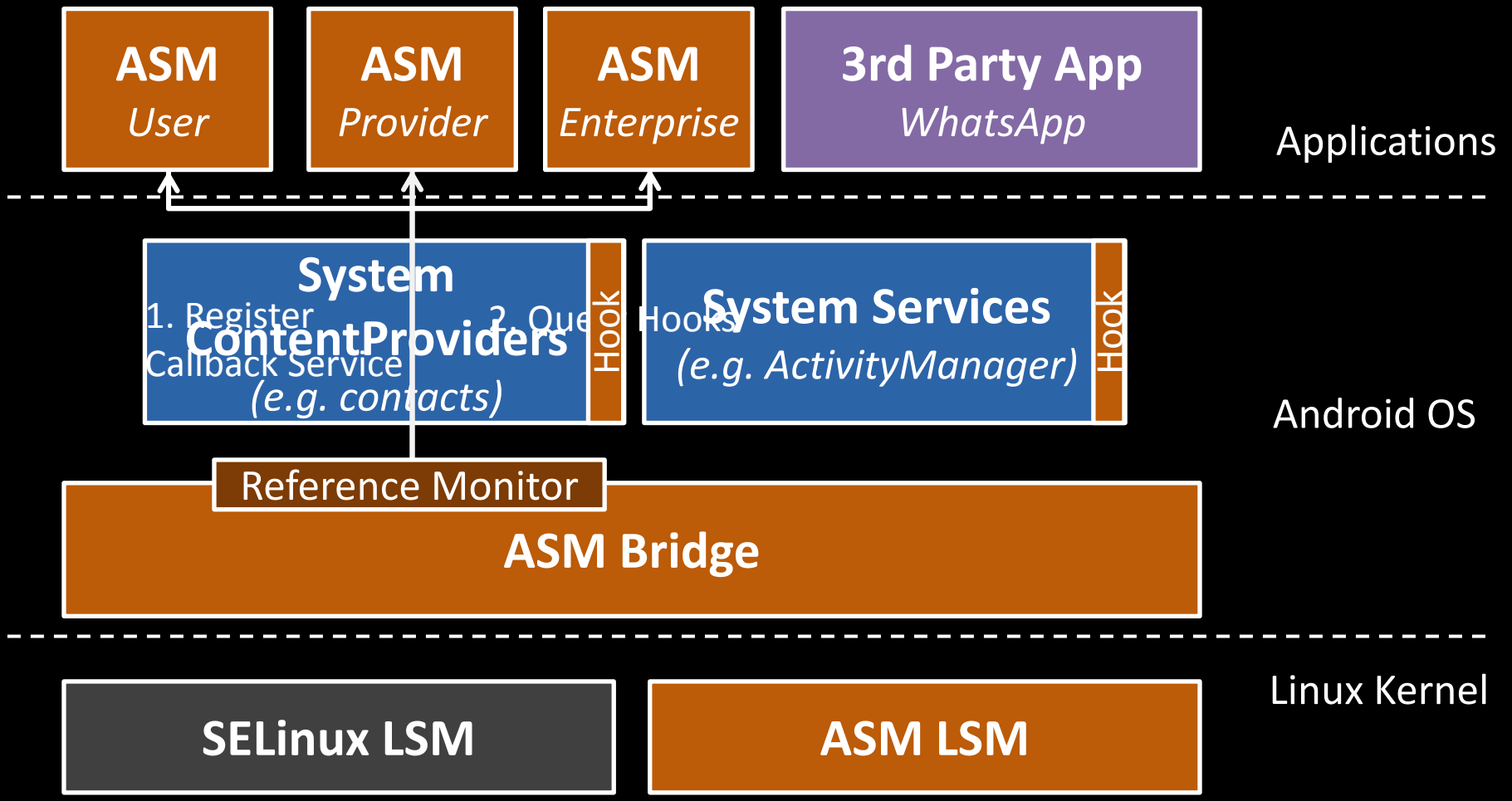
System	Android ICC	Package Manager	Sensors / Phone Info	Fake Data	System Content Providers	File Access	Network Access	3rd Party Hooks
MockDroid		✓	✓	✓	✓		✓	
XManDroid	✓	✓	✓			✓	✓	
TrustDroid	✓	✓			✓	✓	✓	
FlaskDroid	✓	✓	✓	✓	✓	✓	✓	✓
CRePE	✓		✓					
Quire	✓	✓						
TaintDroid	✓		✓			✓	✓	
Kirin		✓						
IPC Inspection	✓	✓						
AppFence	✓	✓	✓	✓	✓	✓	✓	
Aquifer	✓					✓	✓	
APEX	✓	✓	✓					
Saint	✓	✓						✓
SEAndroid	✓	✓				✓	✓	
TISSA			✓	✓	✓			

High-level Idea of ASM

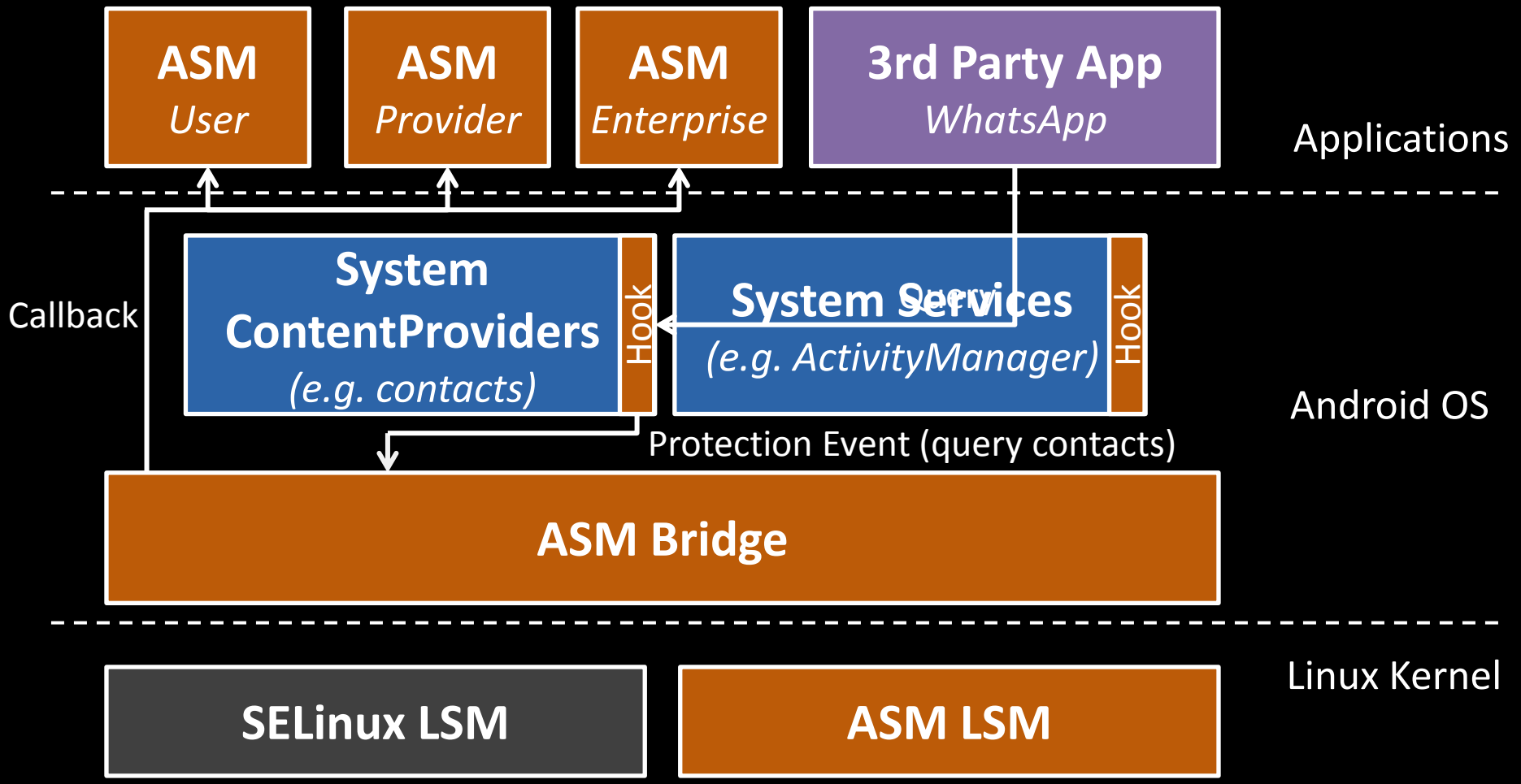
- A *modular* access control architecture supporting *multiple stakeholders*
- Deploy *Android Security Modules (ASMs) as apps*



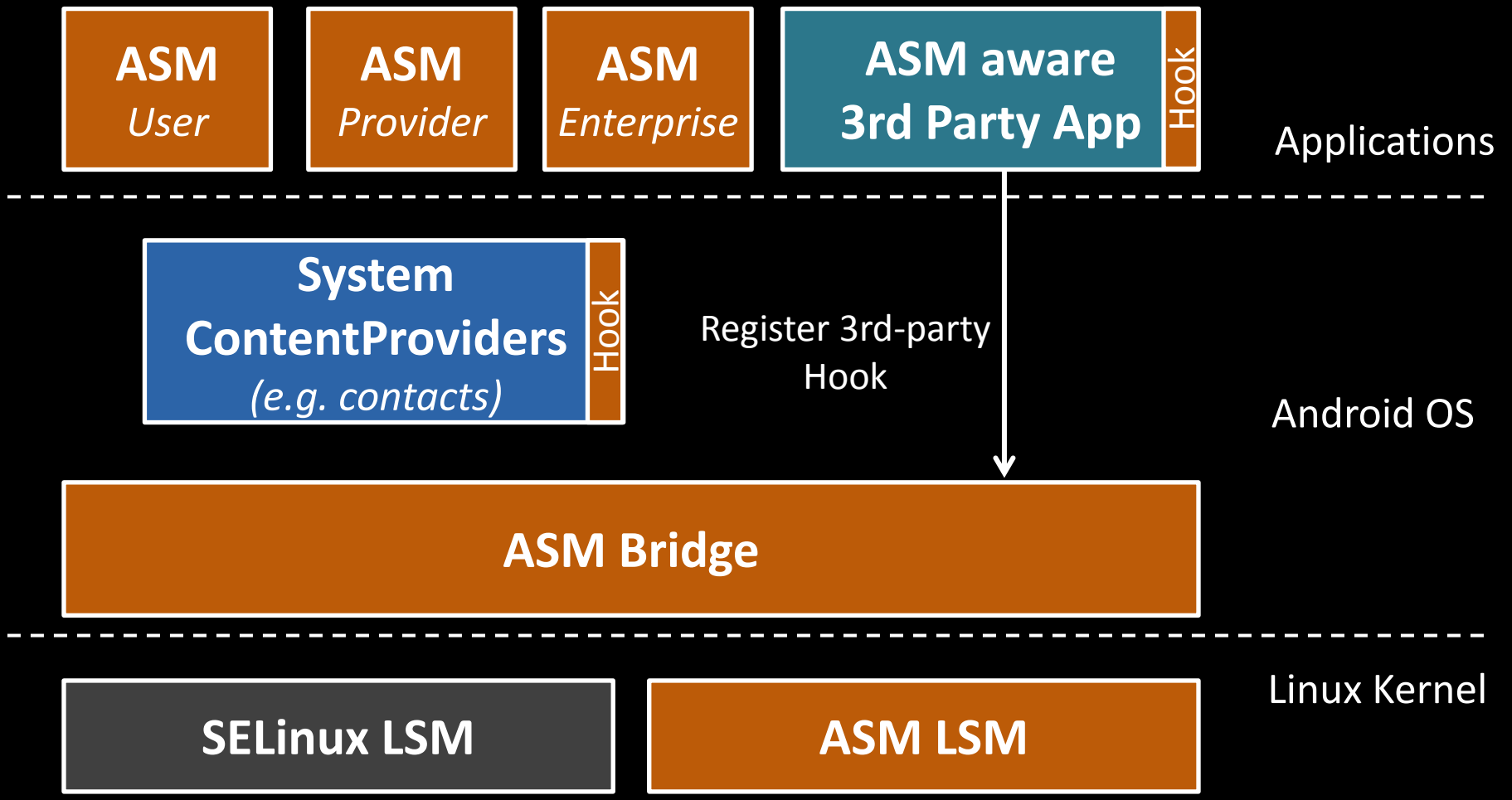
ASM Framework



Hook Invocation

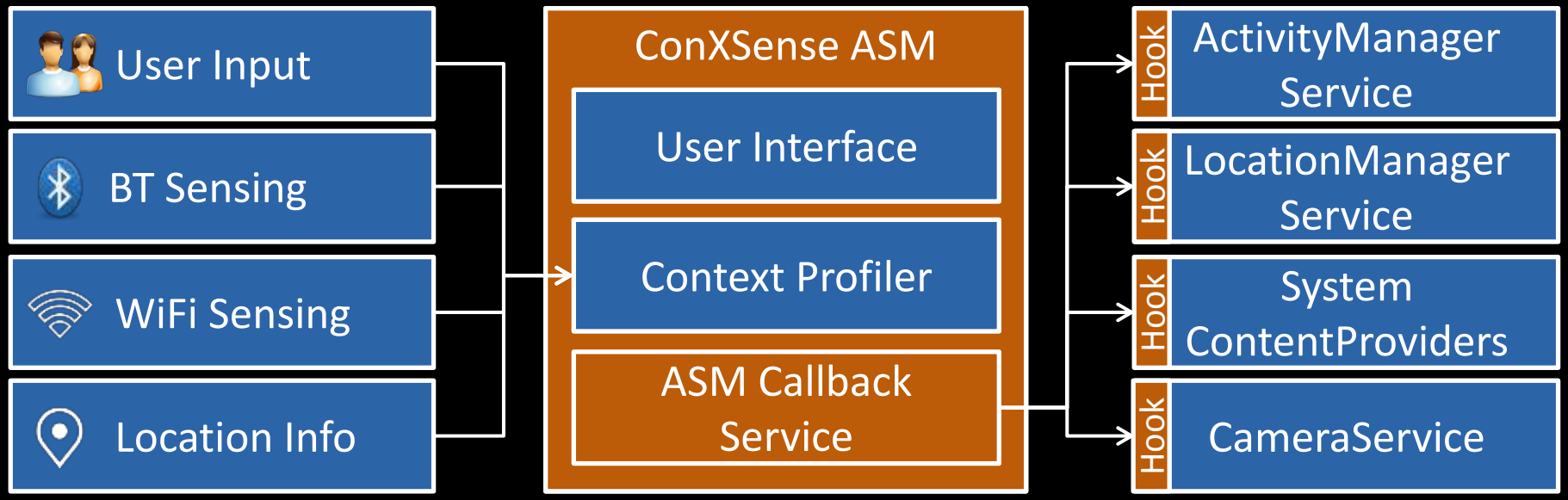


Support for 3rd-Party Hooks



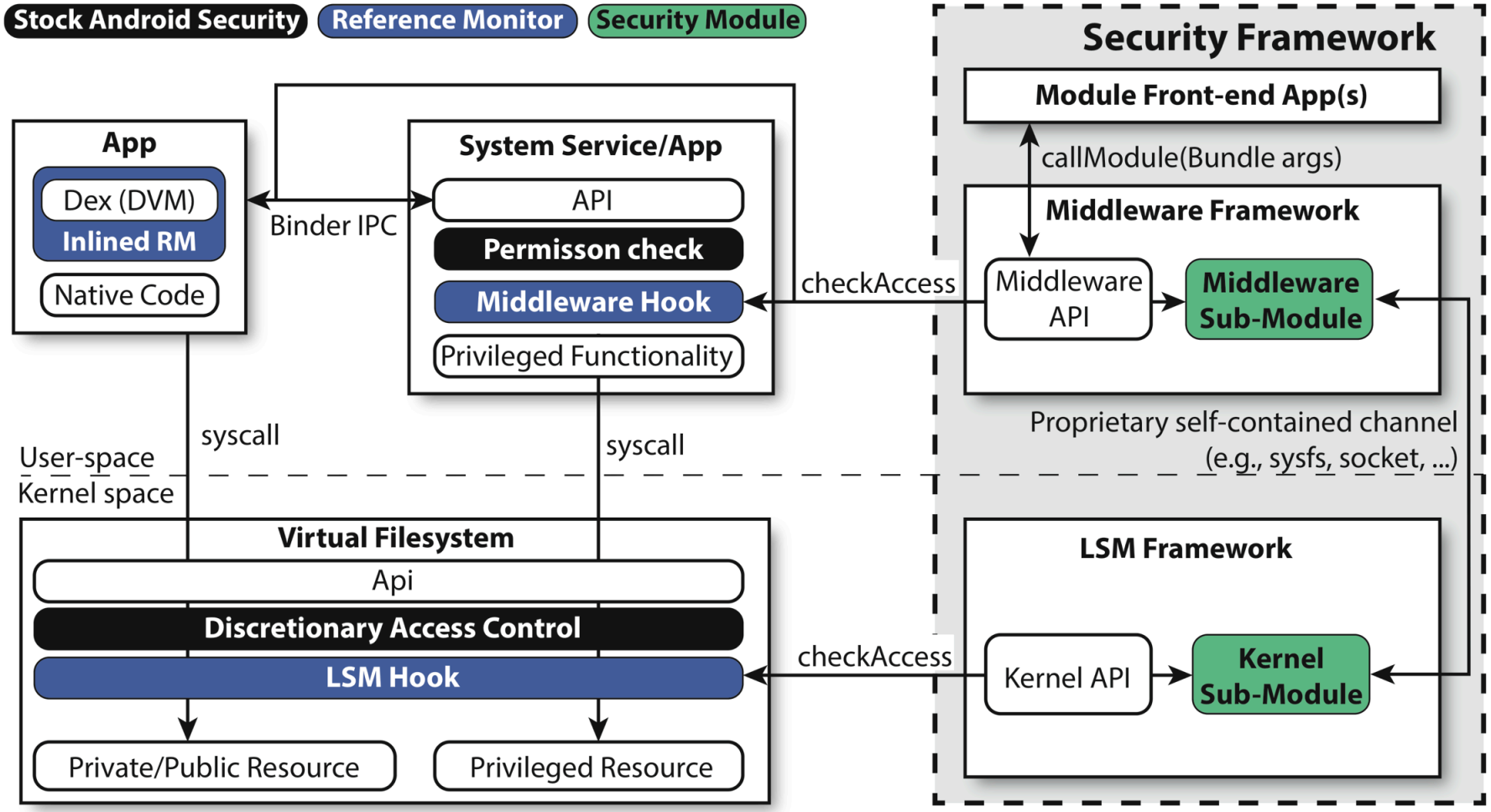
ConXSense
Context Aware Access Control

- Goal: Context-aware access control
  - Context-aware access control enforcing policies by user context profiling
  - Includes access control on sensors (e.g., GPS and camera), sensitive information (e.g., contacts) and apps
- ASM based implementation:



ConXSense [ASIACCS 2014]

ASF Design


Stock Android Security
Reference Monitor
Security Module
Security Framework
Module Front-end App(s)
callModule(Bundle args)
Middleware Framework
App
Dex (DVM)
Inlined RM
Native Code
Binder IPC
System Service/App
API
Permisson check
Middleware Hook
Privileged Functionality
checkAccess
Middleware API
Middleware Sub-Module
Proprietary self-contained channel
(e.g., sysfs, socket, ...)
syscall
syscall
User-space
Kernel space
Virtual Filesystem
Api
Discretionary Access Control
LSM Hook
Private/Public Resource
Privileged Resource
LSM Framework
checkAccess
Kernel API
Kernel Sub-Module

ASF API AND USE-CASES

- Security API
  - 136 functions for enforcement hooks in all major system services and apps
  - Hooks support *edit automata* policies (i.e., modification of return values instead of only deny/allow decision)
- Use-cases: Porting previous research prototypes as modules on ASF
  - FlaskDroid/SE Android (type enforcement at middleware and kernel level)
  - TrustDroid (domain isolation private vs work)
  - CRePE (Context-aware access control)
  - AppOps and IntentFirewall (dormant Android features by Google)
  - AppGuard (IRM)
  - XManDroid (Chinese wall policies)
  - Saint (Developer policies)
  - Data shadowing
- In general minimal overhead of porting those use-cases to our system

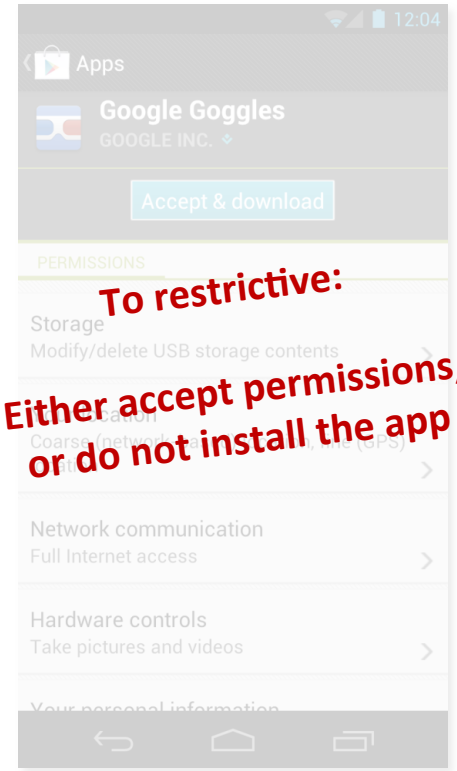
Android Security Extensions

Inlined Reference Monitoring [38]

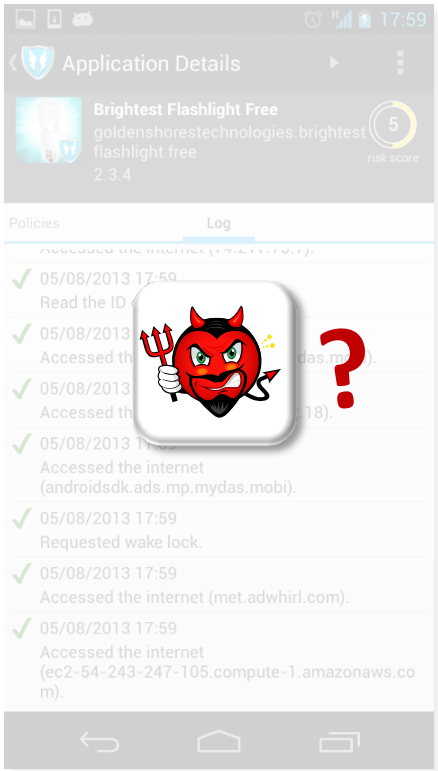
http://www.wired.com/images_blogs/gadgetlab/2011/12/new-prof.png

Motivation

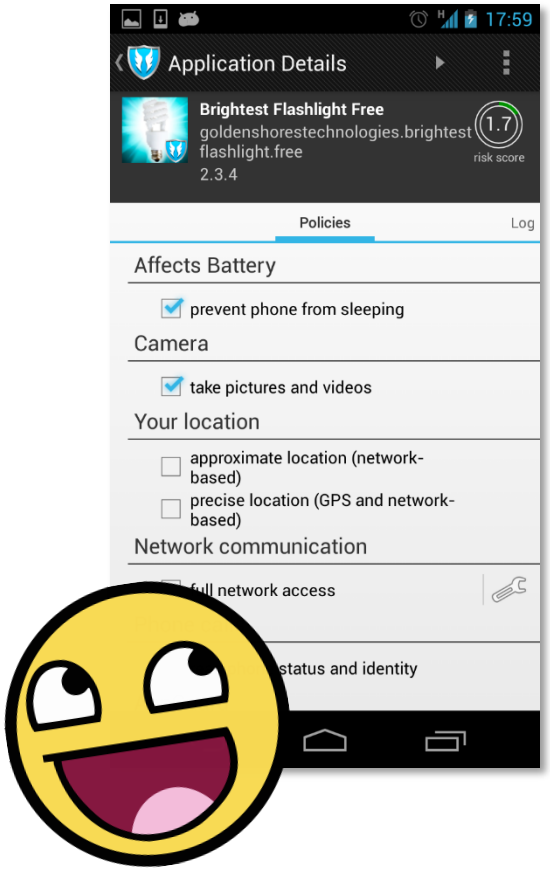
Existing permission system



Understand an apps behavior



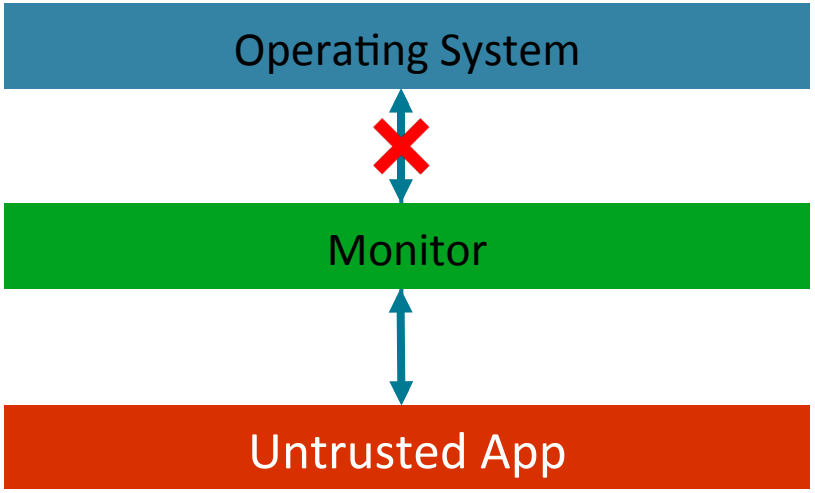
Enforce a desired level of privacy



How to enforce such dynamic permissions?

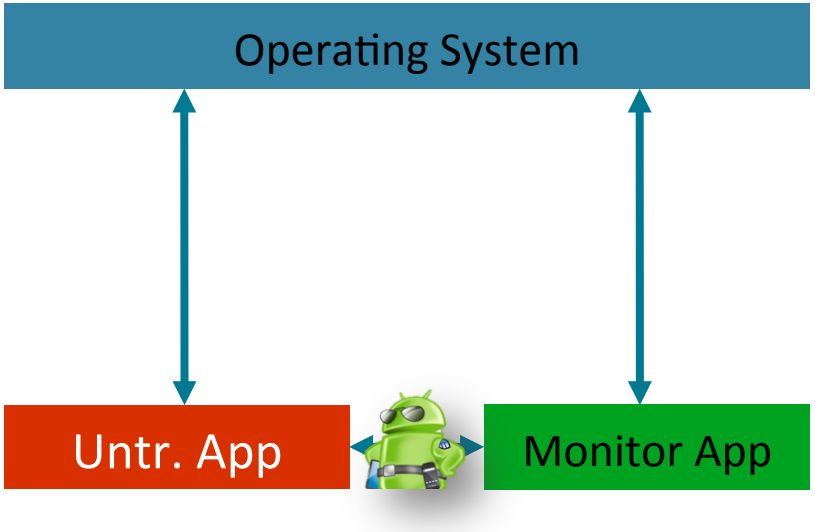
Problem Description

- Ideally performed at OS / Middleware layer
  → Requires firmware modification!



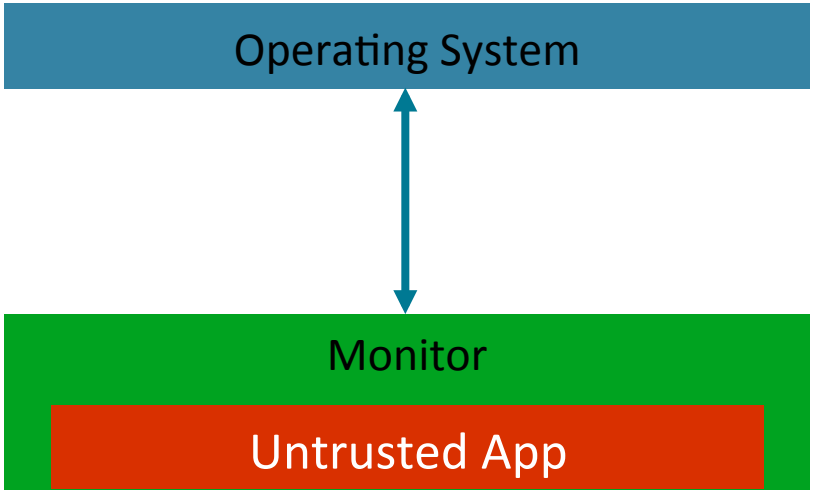
Problem Description

- Ideally performed at OS / Middleware layer
  → Requires firmware modification!
- Android isolates app processes: “all apps are created equal”
  → Monitor not privileged enough!

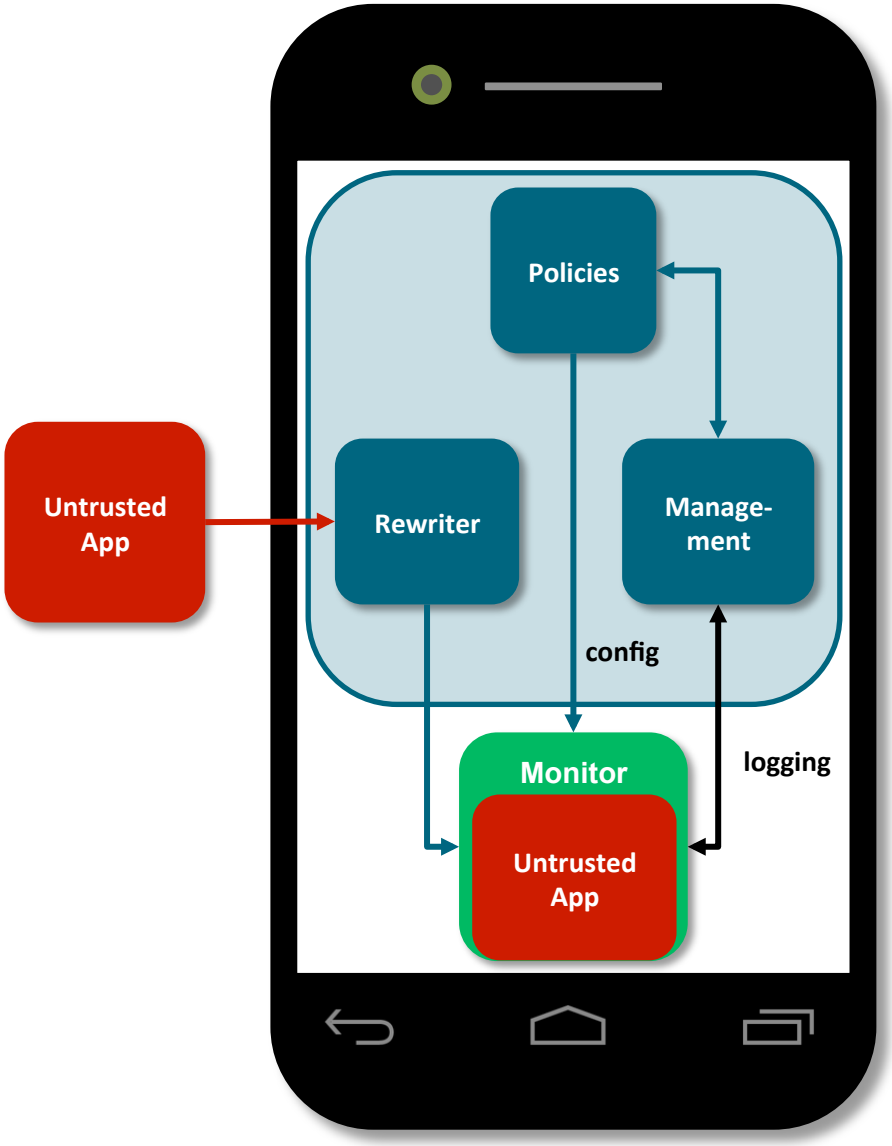


Problem Description

- Ideally performed at OS / Middleware layer
  → Requires firmware modification!
- Android isolates app processes: “all apps are created equal”
  → Monitor not privileged enough!
- **Solution:** Combine monitor and app into “self-monitoring” app



AppGuard – Conceptual Overview



Implemented as stand-alone app:

→ **easily deployable**

Inline Reference Monitoring

- **Dynamic Access Control**
  - Prevent apps from accessing certain system resources
  - Revocation and re-granting of permissions
- **Fine-granular Security Policies**
  - Comprehensible for user
  - Expressive for developer
- **"Graceful degradation"**
  - Apps should not crash after access to restricted resource
- **No change to the OS**
  - Deployment as regular Android app (**no** root)

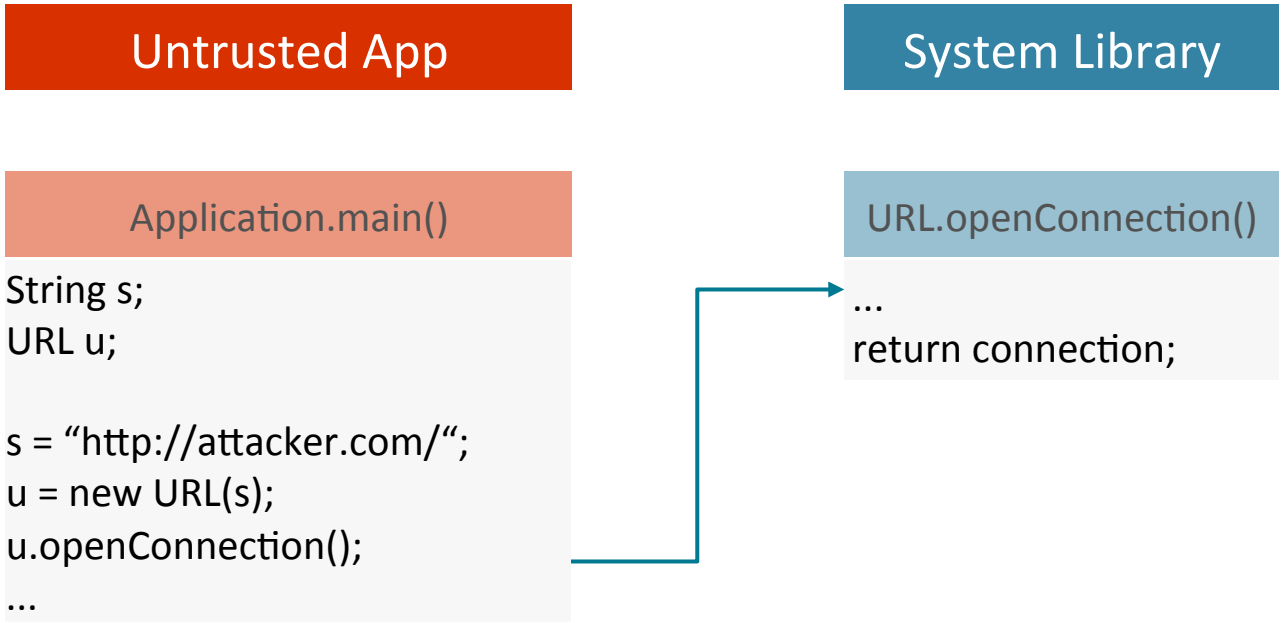
Inline Reference Monitoring

- **Goal:** Mediate security-relevant operations
  - Monitor program behavior at critical points
  - Instrument program to redirect control flow to the monitor
  - Take action based on security policy
    - Terminate program
    - Suppress operation

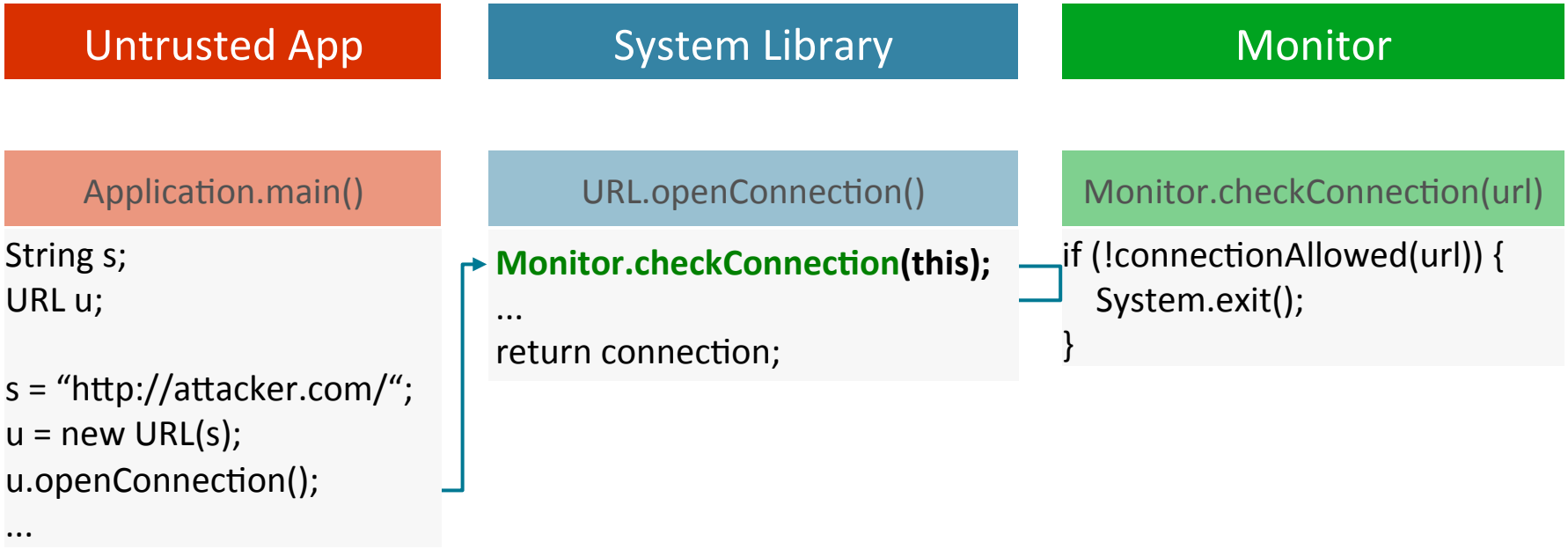
- Security-relevant operations
  - Function calls: Java Core API, Android API
  - Control flow redirection either at **caller-site** or **callee-site**

- Typically by bytecode modification

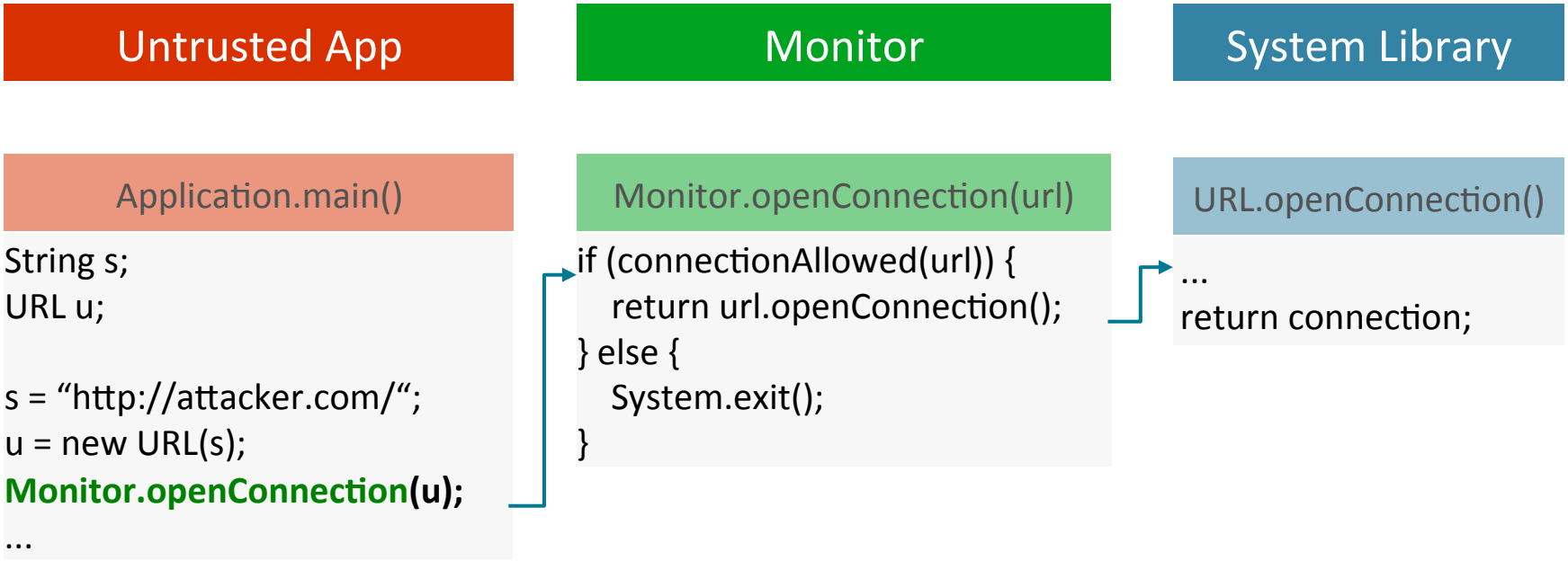
Caller- vs. Callee-Site Rewriting



Callee-Site Rewriting



Caller-Site Rewriting



Caller- vs. Callee-side Rewriting

CISPA Center for IT-Security, Privacy and Accountability

Caller-side

- ✗ Many places to instrument
- ✗ Dynamically loaded code
- ○ Reflection

- ✓ Possible in practice for end-users

Callee-side

- ✓ Few places to instrument
- ✓ Dynamically loaded code
- ✓ Reflection

- ✗ Impossible in practice for end-users

AppGuard: Rewriter

- Rewriter
  - Works directly on Dalvik executable (DEX) bytecode
  - Generates runtime monitor from policies and merges it into the target app
  - Identifies invocations of security-relevant methods within the target app‘s bytecode
  - Rewrites target app to call into the monitor right before every invocation of a security-relevant method (caller-site rewriting)
  - Additional try-catch block allows monitor to suppress the security-relevant method call and return a mock value

AppGuard: Rewriter

CISPA Center for IT-Security, Privacy and Accountability

Original code

```
TelephonyManager tm =
        getTelephonyManager();
String deviceId = tm.getDeviceId();
```

```
URL url = new URL(loc);
try {
    url.openConnection();
} catch (IOException) {
    // handle IOException
}
```

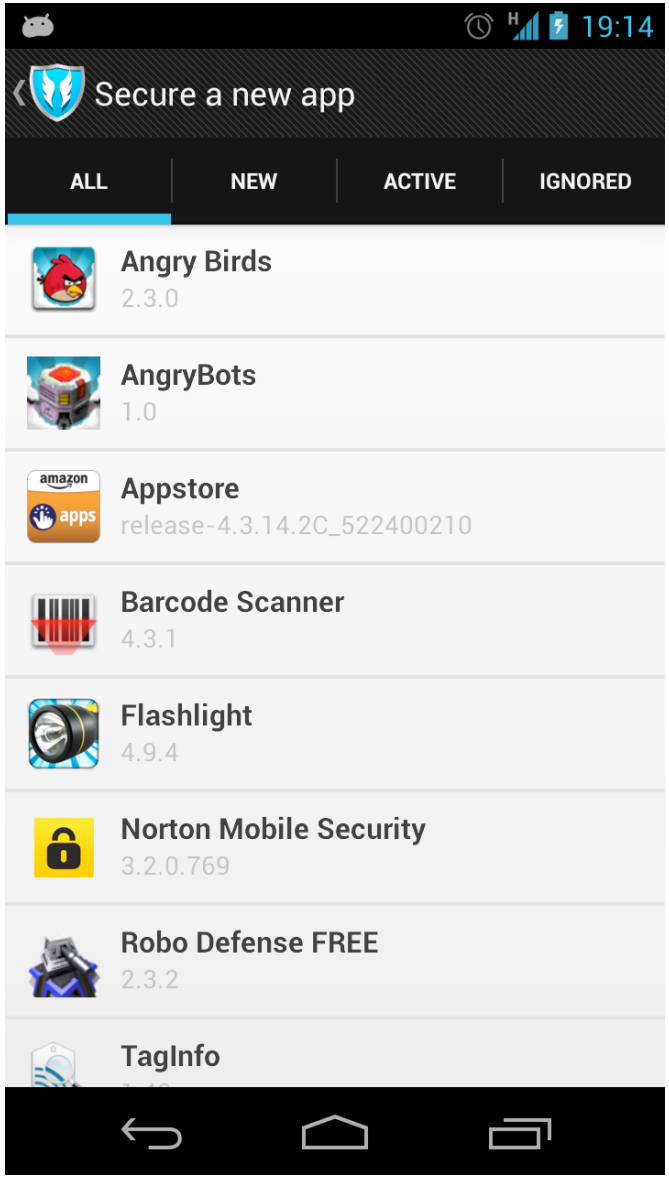
After rewriting

```
TelephonyManager tm =
        getTelephonyManager();
String deviceId;
try {
    Monitor.checkDeviceId(tm);
    deviceId = tm.getDeviceId();
} catch (MonitorException e) {
    deviceId = e.mockValue();
}
```

```
URL url = new URL(loc);
try {
    Monitor.checkConnection(url);
    url.openConnection();
} catch (IOException) {
    // handle IOException
} catch (MonitorException) {
    // no return value, ignore
}
```

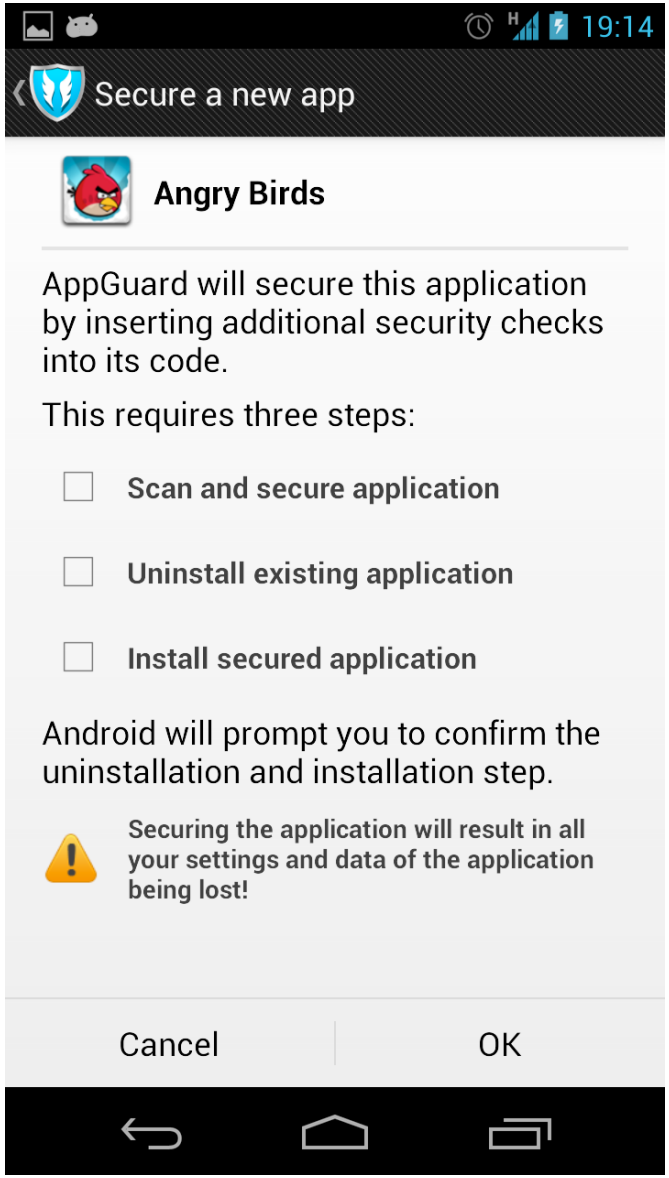
AppGuard: Management

- UI for rewriting apps on the phone



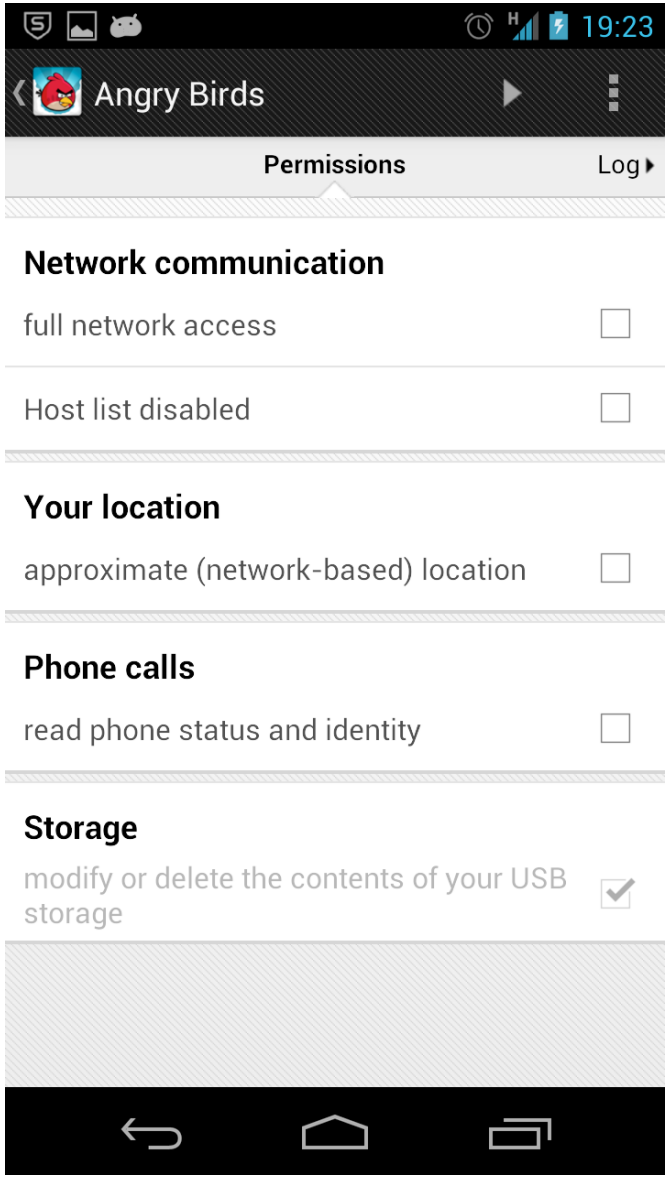
AppGuard: Management

- UI for rewriting apps on the phone



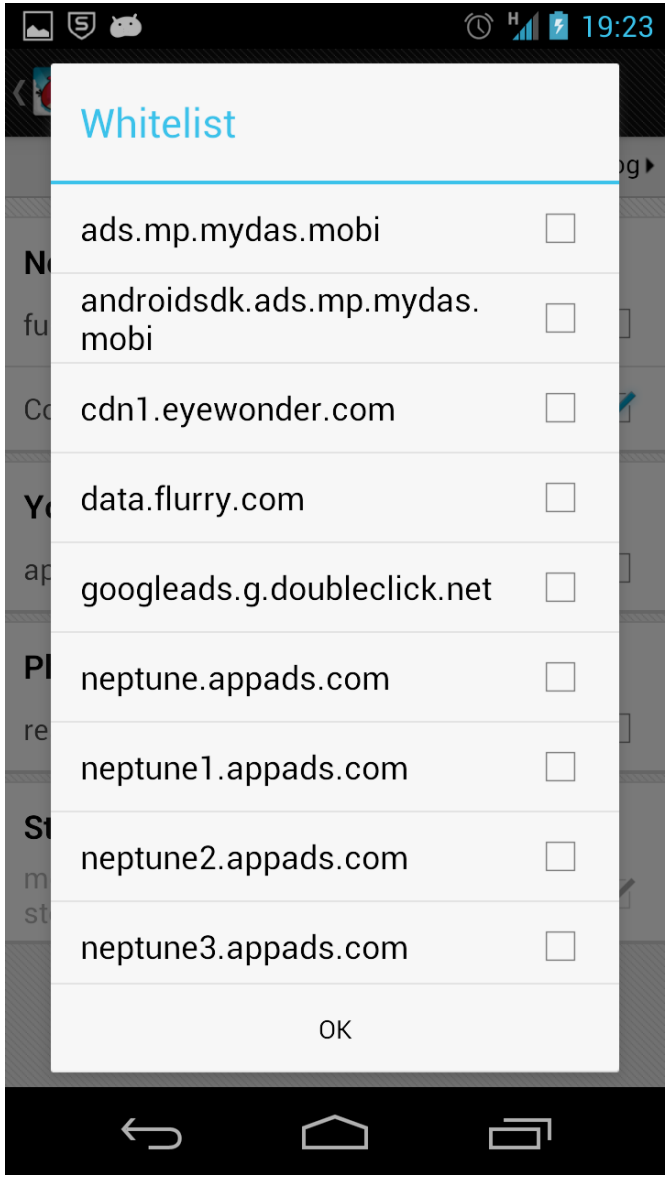
AppGuard: Management

- UI for rewriting apps on the phone
- Policy configuration per app
  - Passed to target app via world-readable config file
  - Fine-grained configuration supported



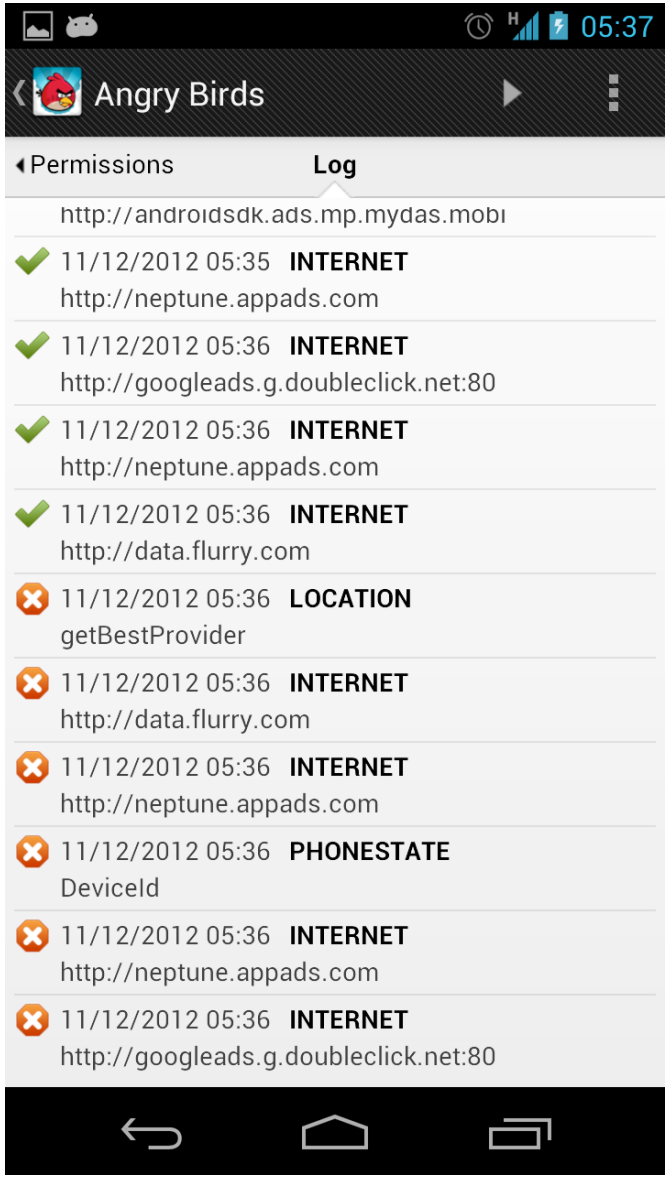
AppGuard: Management

- UI for rewriting apps on the phone
- Policy configuration per app
  - Passed to target app via world-readable config file
  - Fine-grained configuration supported



AppGuard: Management

- UI for rewriting apps on the phone
- Policy configuration per app
  - Passed to target app via world-readable config file
  - Fine-grained configuration supported
- Log of security-relevant events
  - Pushed via IPC from inlined monitor



Wetter.com

- Provides weather information & forecast
- Displays advertisements
- **Situation**
  - Retrieves weather data from wetter.com
  - Requests **INTERNET** permission for full Internet access
- **Solution**
  - Selectively allow access to wetter.com servers only
  - No more advertisements displayed

Twitter

- Mobile client for popular micro-blogging service
- **Situation**
  - Automatically transfers contact data to Twitter servers without user‘s knowledge or consent
  - Part of Twitter‘s „find friends“ feature
- **Solution**
  - Block access to user‘s contact data
  - Friends can still be added manually

Endomondo Sports Tracker

- Tracks your outdoor sport activities (running, cycling, etc...)
- Creates personal sports profile
- **Situation**
  - Leaks authentication token via **`HTTP`**
- **Solution**
  - Intercept **`HTTP`** connections and redirect to encrypted **`HTTPS`**

(Evil) Tea Timer

- Simple timer app
- Requires **INTERNET** permission only
- **Situation**
  - Uploads user‘s personal photos to public photo sharing site
  - No permission required to access photos storage
- **Solution**
  - Block access to photo storage

AppGuard: Discussion

- Practical solution to a pressing security problem
  - Negligible runtime overhead (< 6%)
  - Reasonable rewriting time (5-60 seconds)
  - Deployed & widely adopted (~1 million downloads over 8 months)
- General purpose lightweight runtime instrumentation
  - Only minimal static rewriting (caller-site) necessary
- Limitations
  - Native code
  - Re-implementation
  - Stealth

Conclusion

- Mobile security a very active research area
  - Feature-rich smartphones and “appification” have induced security research on various (new) aspects
- Android’s open-source nature has made Android very attractive to security researchers
  - Many lessons learned for concurrent and future mobiles Oses

Acknowledgements

- Luca Davi (CASED/TU Darmstadt/ICRI-SC @ TU Darmstadt) for his overview slides
- Sascha Fahl (Uni Hannover) for sharing his CCS'12 and CCS'13 slides on SSL vulnerabilities
- Stephan Heuser (CASED/TU Darmstadt) and William Enck (NCSU) for publishing their slides on ASM and TaintDroid, respectively