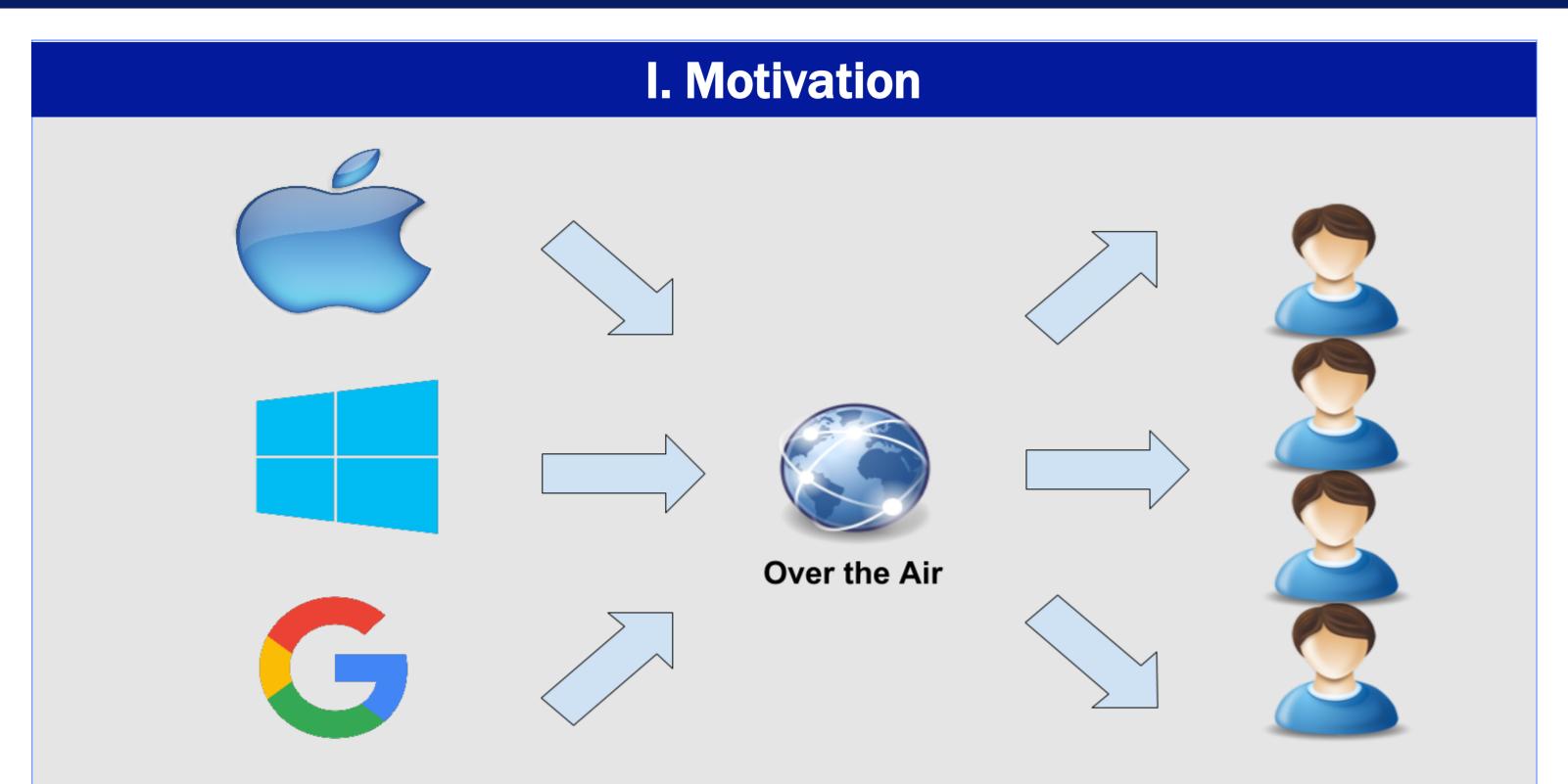


Realizing API Virtualization on Android

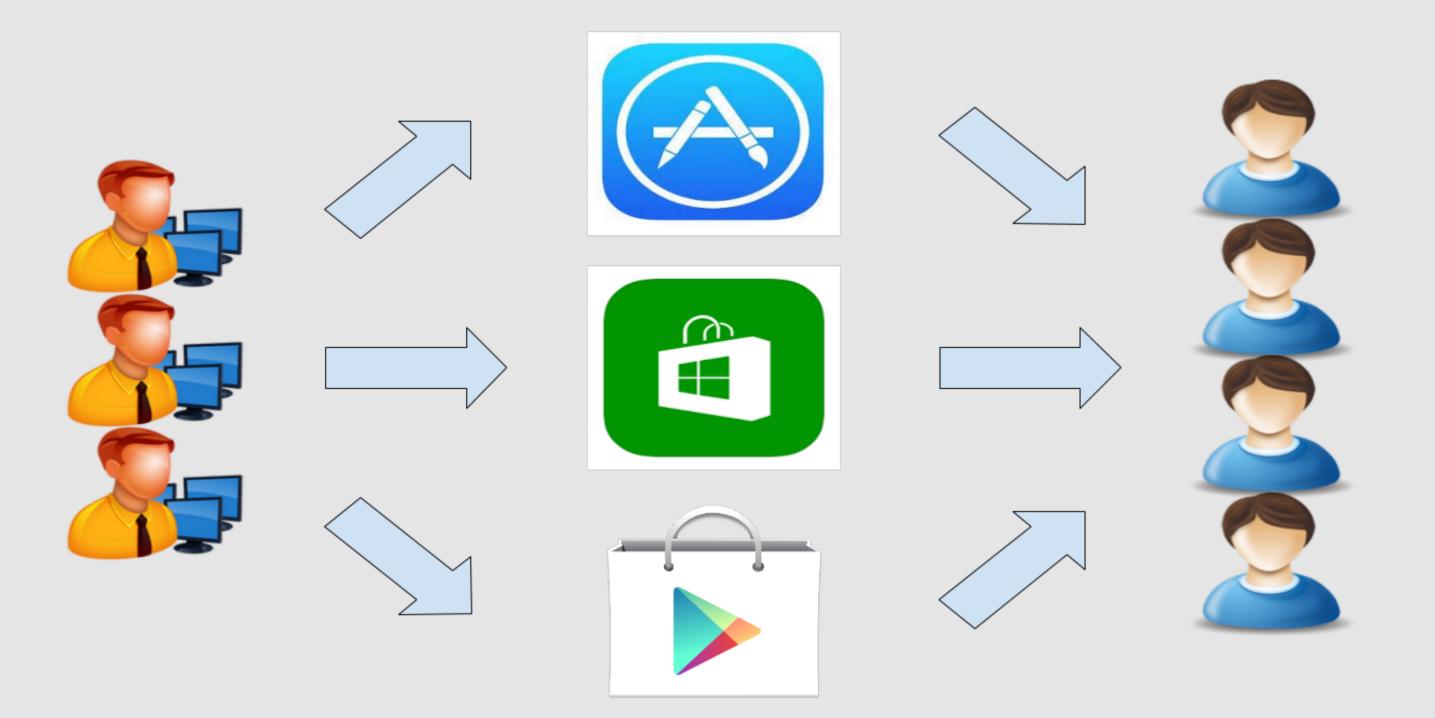
Taeyeon Ki, Alexander Simeonov, Bhavika Pravin Jain, Chang Min Park, Keshav Sharma Karthik Dantu, Steven Y. Ko, Lukasz Ziarek



Instrumentation Statistics						
App Name	#Class	APK Size	Inst. Time			
WatchESPN (Sports)	7192	9.7M	N/A			
WatchESPN*	9388	11M	133.1 (sec)			
The Weather Channel (Weather)	8377	14M	N/A			
The Weather Channel *	10724	16M	146.2 (sec)			
TempleRun (Game)	1213	23.8M	N/A			
TempleRun*	2689	24.7M	26.44 (sec)			

Power Consumption Measurement

Mobile vendors control platform distribution channels.



Unlike mobile platforms, mobile apps are open for third parties.

II. Propose

			 -	-	

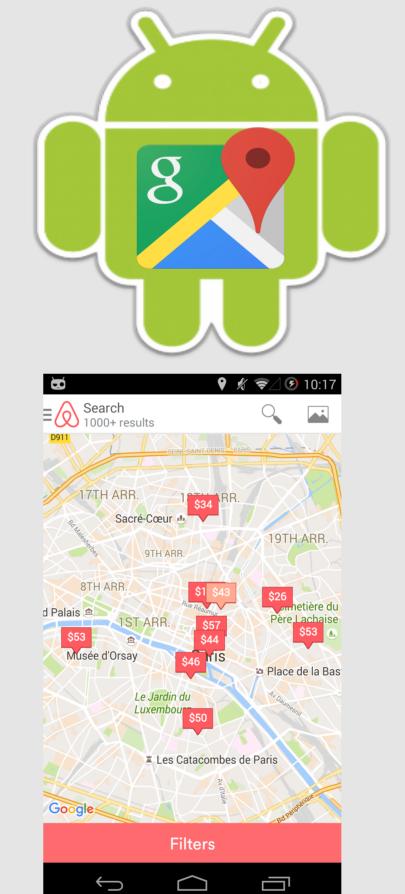
□ Injecting a replacement class

App Name	Average Consumption (10 minutes / 5 runs)	Std. Deviation
WatchESPN (Sports)	781.5	20.0
WatchESPN*	790.3	17.4
The Weather Channel (Weather)	170.2	13.6
The Weather Channel *	181.4	8.9
TempleRun (Game)	991.5J	29.5J
TempleRun*	992.95J	22.3J

() denotes application category and * denotes an instrumented app.

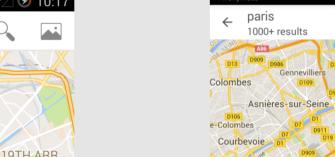
V. Use Cases

<u>1. Vendor-Tied Library Switching</u>: Google Maps to Amazon Maps

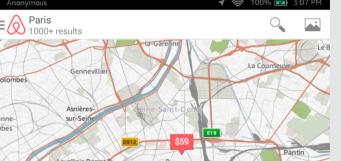


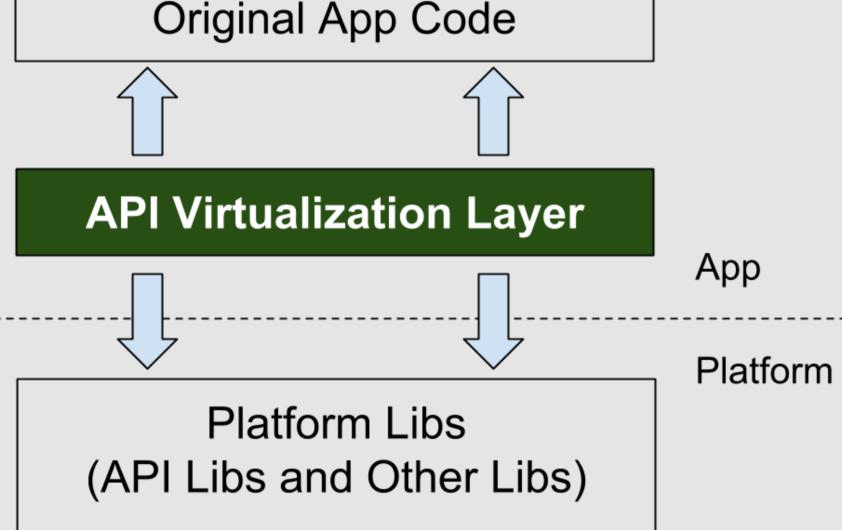
Transformation

with API virtualization









- that contains custom code for each platform API class that a third-party developer wants to replace
- Rewriting the binary of an app so that the app code uses replacement classes instead of platform API classes
- Distributing the new implementa-tion through standard app distribution channels



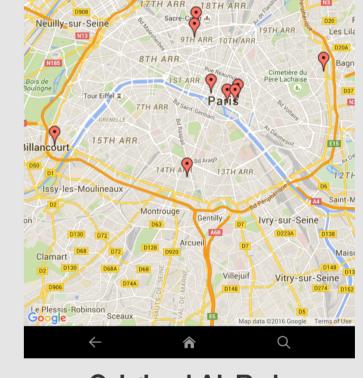
Mitigating the lack of openness in mobile systems by proposing API Virtualization • Exploring and addressing a unique set of challenges that API Virtualization brings in order to correctly and completely handle all features of Android and Java. Realizing API Virtualization prototype, and showing its feasibility and practicality

IV. Initial Results

- Samsung Galaxy Nexus Devices running Android 4.4
- Enabling stay-awake mode
- Set CPU governor to "Performance"

Call Latency to Invoke Platform Methods

Heap Usage of Temple Run



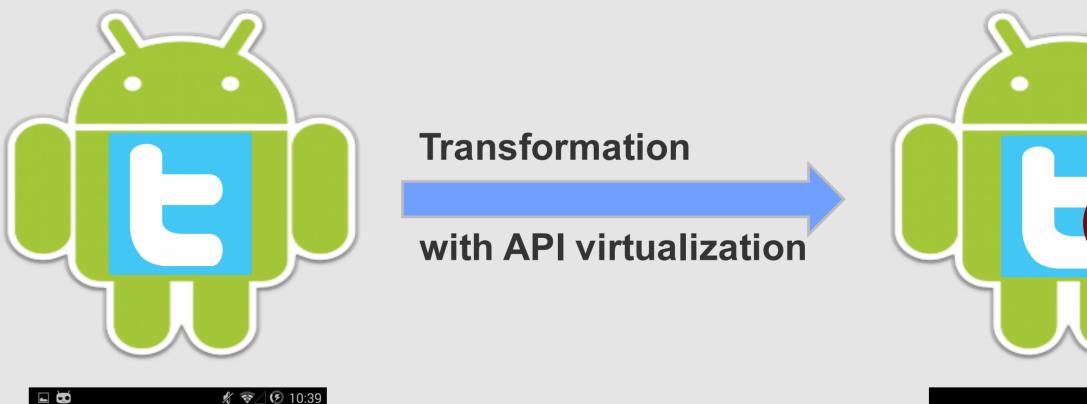
Original AirBnb with Google Play Services on a Google device

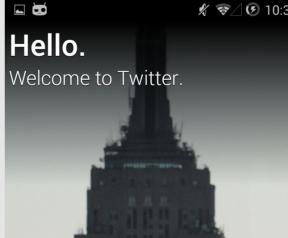
Original AirBnb on an Amazon device



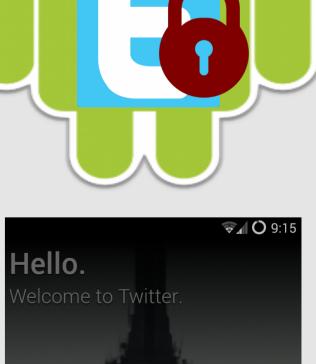
on an Amazon device

<u>2. Runtime Permissions</u>: Runtime Internet Permission

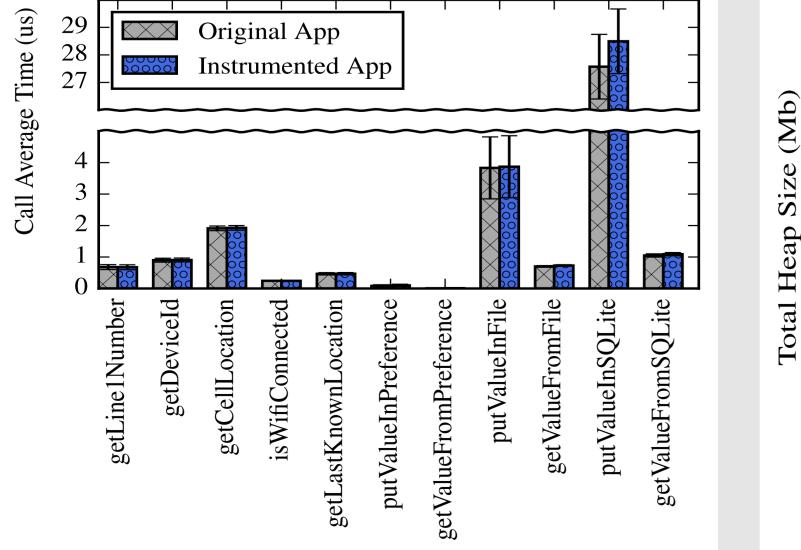


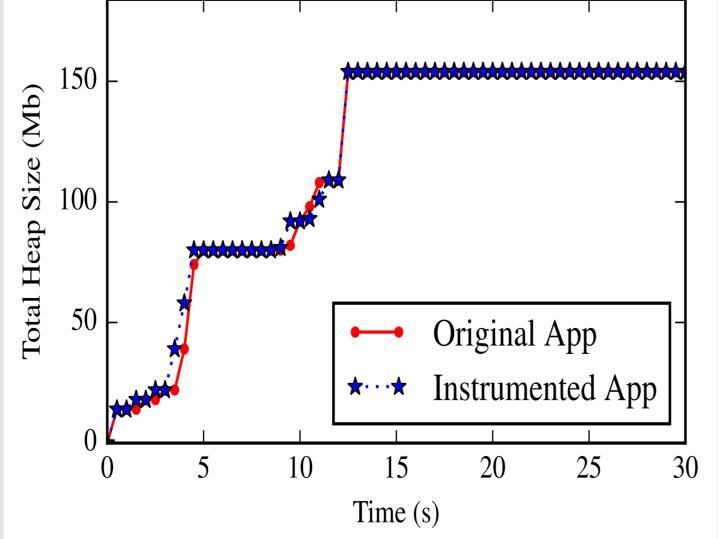






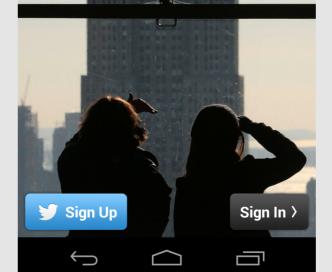
Injecting a runtime





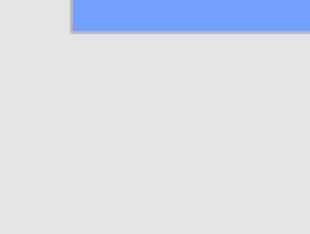
□ To measure call latency, we use a micro-benchmark app that calls eleven platform methods from four categories: device information, network, storage, and sensing (GPS).

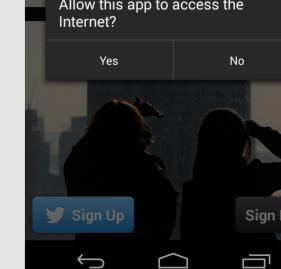
□ To measure runtime memory usage, we use one popular game that uses accelerometer and gyroscopes on a mobile phone for game play, and contains a heavy UI component.



Original Twitter

Internet permission





ermission Request

Instrumented Twitter with a runtime Internet permission

VI. Conclusion

API Virtualization enables open innovation in Android. Also, it allows third-party developers to inject custom code into an app binary. Through API virtualization prototype on Android, we show the feasibility and practicality of our API virtualization, and the low overhead that API virtualization imposes.