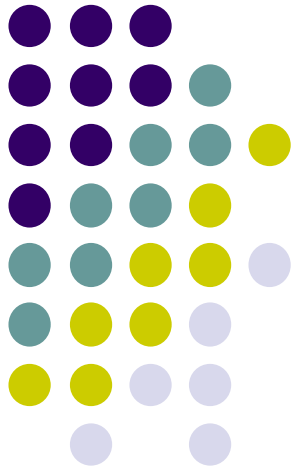
Ubiquitous and Mobile Computing CS 528: Information Leakage through Mobile Analytics Services

Punit Dharani

Evin Ugur

Computer Science Dept.

Worcester Polytechnic Institute (WPI)



Overview

- Introduction – EU
- Related Work – PD
- Extracting User Profiles – EU
  - Methodology
  - Validation
- Influencing Advertisements - PD
  - Methodology
  - Validation
- Implications - PD
- Countermeasures – EU
- References

Introduction

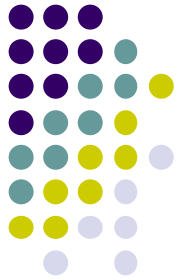
What?

- In-App Ads are a popular revenue model for app developers
- Profiles for Ad Services contain sensitive information, and can be extracted
- With these profiles compromised, ads served can be influenced.

Why?

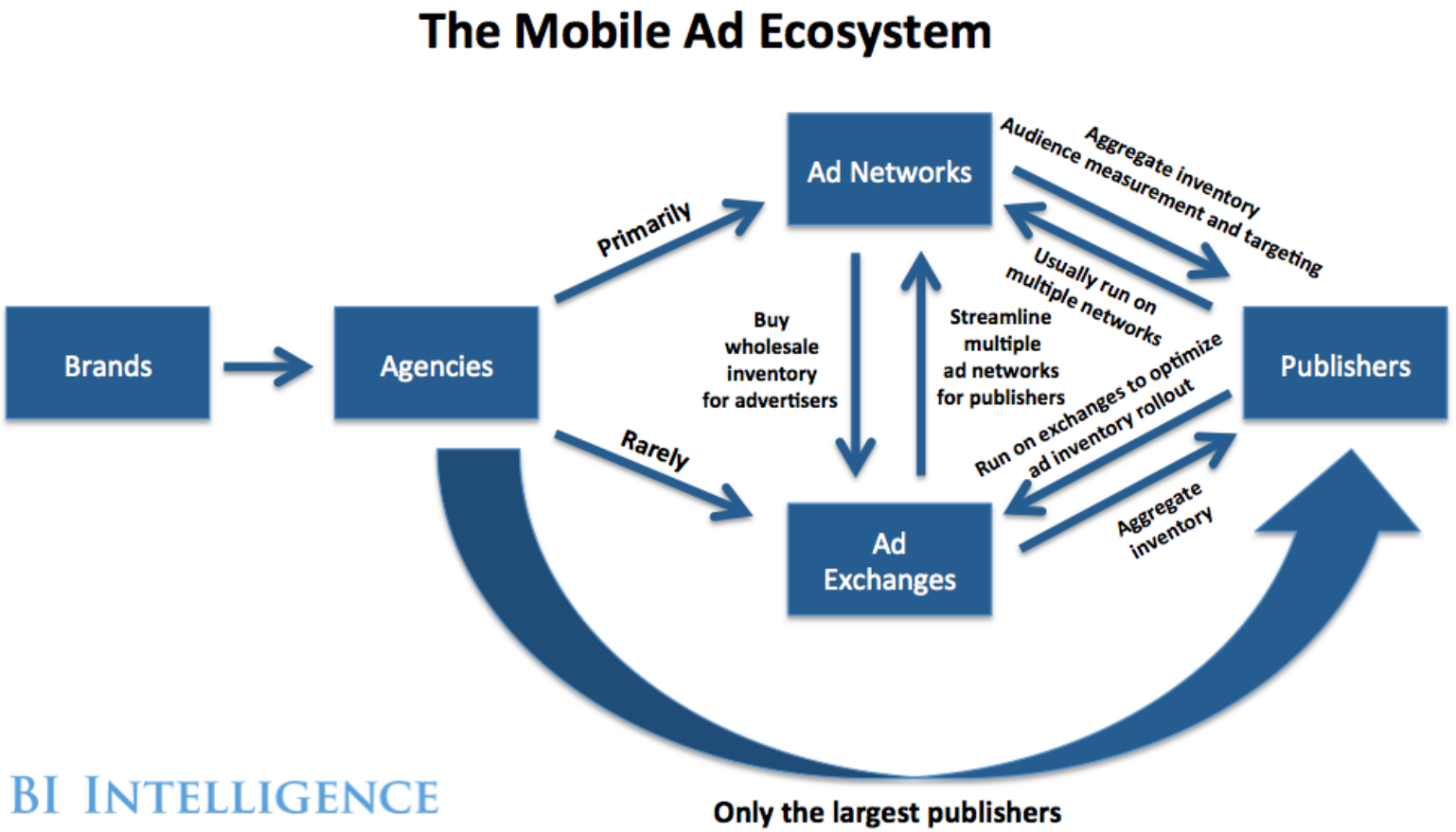
- Privacy Concerns! - $$$

Related Work



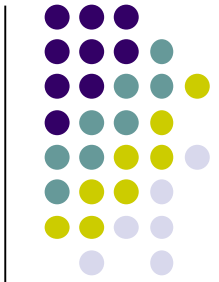
- Don't kill my ads!: balancing privacy in an ad-supported mobile application market
  - feedback control loop for AD privacy adjustment
- MAdFraud: Investigating Ad Fraud in Android Application
  - Methods for identifying ad fraud – we will soon present a way to create ad fraud

Introduction - Background



http://www.businessinsider.com/bii-report-the-mobile-advertising-ecosystem-explained-2012-12

Methodology



Two Phases:

1) Extraction of User Profiles

2.) Influencing Ads Served

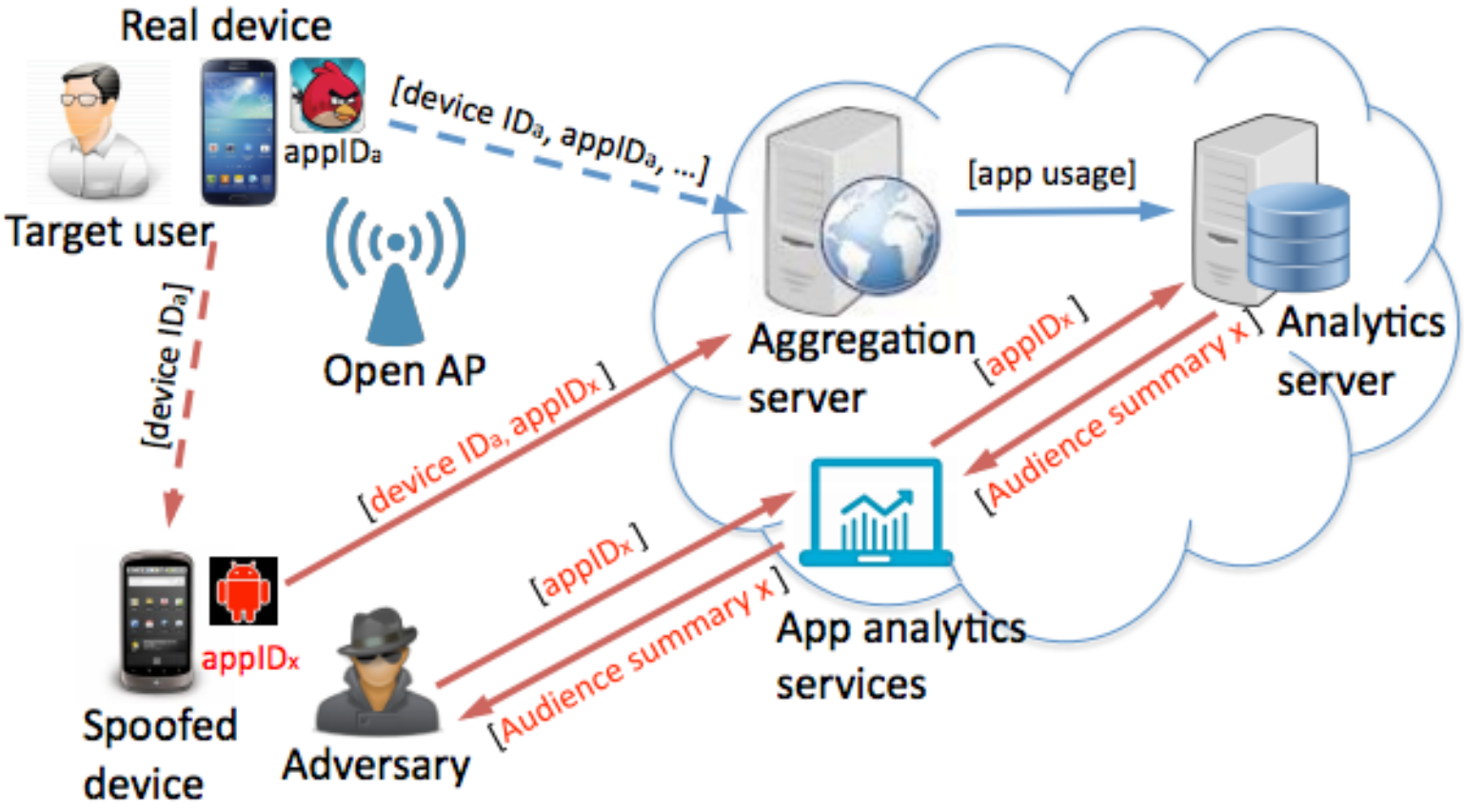
Methodology: 1.) Extraction of User Profiles

- User Profile – a set of info collected or inferred by the ad service
  - Basic: Age, Gender, Language, Geography
  - Creepy: Singles, New-Moms, High Net-Worth
- Extraction is performed by impersonating the user, and ultimately performing actions on their behalf
  - Google – identified by Android ID, triggered from AD Settings
  - Flurry must cause communication with bespoke app

Methodology: 1.) Extraction of User Profiles (Continued)

- Monitor the network for device IDs
  - On a public hotspot? Throw up a net and capture 1000s of IDs
  - Private Network? Capture your friend, coworker, etc.
- Modify values of identified parameters on a rooted Android Device & You've Spoofed your Target

Methodology: 1.) Extraction of User Profiles (Continued)



Validation: 1.) Extraction of User Profiles

- Experiment with 44 Users – aim is to show they can be spoofed
  - Instantiate a new usage report from ad service on real device and from a spoof with the same app ID
  - Report served has identical device IDs despite being run on different devices

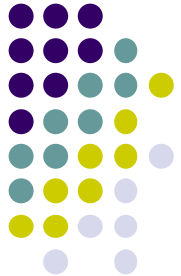
Methodology: 2.) Influencing Ads Served

- Impersonating target devices using Spoofed user profiles

Profile Training – training the user profiles by running apps from a targeting category i.e Business apps

Perturb a profile – running app from different categories for significantly longer periods to set a new dominant category

Methodology: 2.) Influencing Ads Served (Continued)



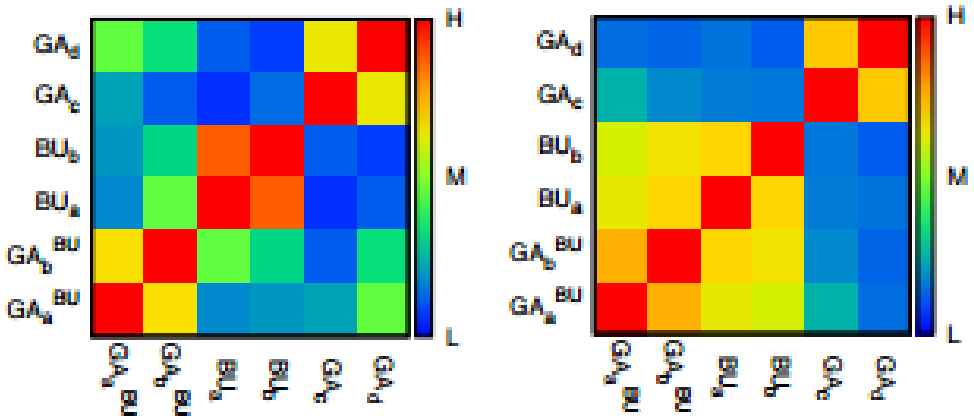
Ad collection: in-app ads delivered via HTTP

tcpdump on Android to monitor ad traffic

Captured traffic pulled from device every 10 minutes

Validation: 2.) Influencing Ads Served

- Jaccard Index between set of unique ads received by all profiles



(a) Google (b) Flurry

Figure 6: Unique ads similarity before and after profile perturbation. (H - high, M - moderate and L - low)

Implications

- Exposure of personal information
- Malicious attacks increasingly sophistication
- Industry awareness (manufacturers, OS, advertisers, etc.)
- Theoretical comrpomization of entire monetization model

Countermeasures

- Google hashes Device ID
  - Not strong enough since it can still be sent by other libraries in plain text and then trivially mapped to the hash
- Implement user ID & advertising ID
  - Lets users reset their profiles – akin to clearing cookies in a browser
- Utilize SSL – Conflict of Interests with Ad
- Public Key Signing Model with Ad Network
  - Uses certificates; Powerful, but not practical – industry wide effort to implement

Countermeasures (Continued)

- Using SSL Prevents Easy Interception – but adds Bandwidth
  - Increases ad load time – conflict of interest
  - Eats into data plans on the aggregate of those with limited data

protocol	onStartSession		getAds		total/hour	
	latency	bandwidth	latency	bandwidth	latency	bandwidth
HTTP	160±1 ms	422 B	160±1 ms	340±2 B	4,400±380 ms	9,425±731 B
HTTPS	800±5 ms	3288 B	800±5 ms	2000±269 B	8,200±950 ms	390,645±36,611 B

References

- *Crussel, Jonathan, Ryan Stevens, and Hao Chen. MAdFraud: Investigating Ad Fraud in Android Applications. Rep. N.p.: n.p., n.d. Print.*
- *Insider, Business. "BII REPORT: The Mobile Advertising Ecosystem Explained." Business Insider. Business Insider, Inc, 26 Jan. 2013.*
- *Leontiadis, Ilias, Christos Efstratiou∗, Marco Picone, and Cecilia Mascolo. Don't Kill My Ads! Balancing Privacy in an Ad-Supported Mobile Application Market. Rep. N.p., n.d. Web.*