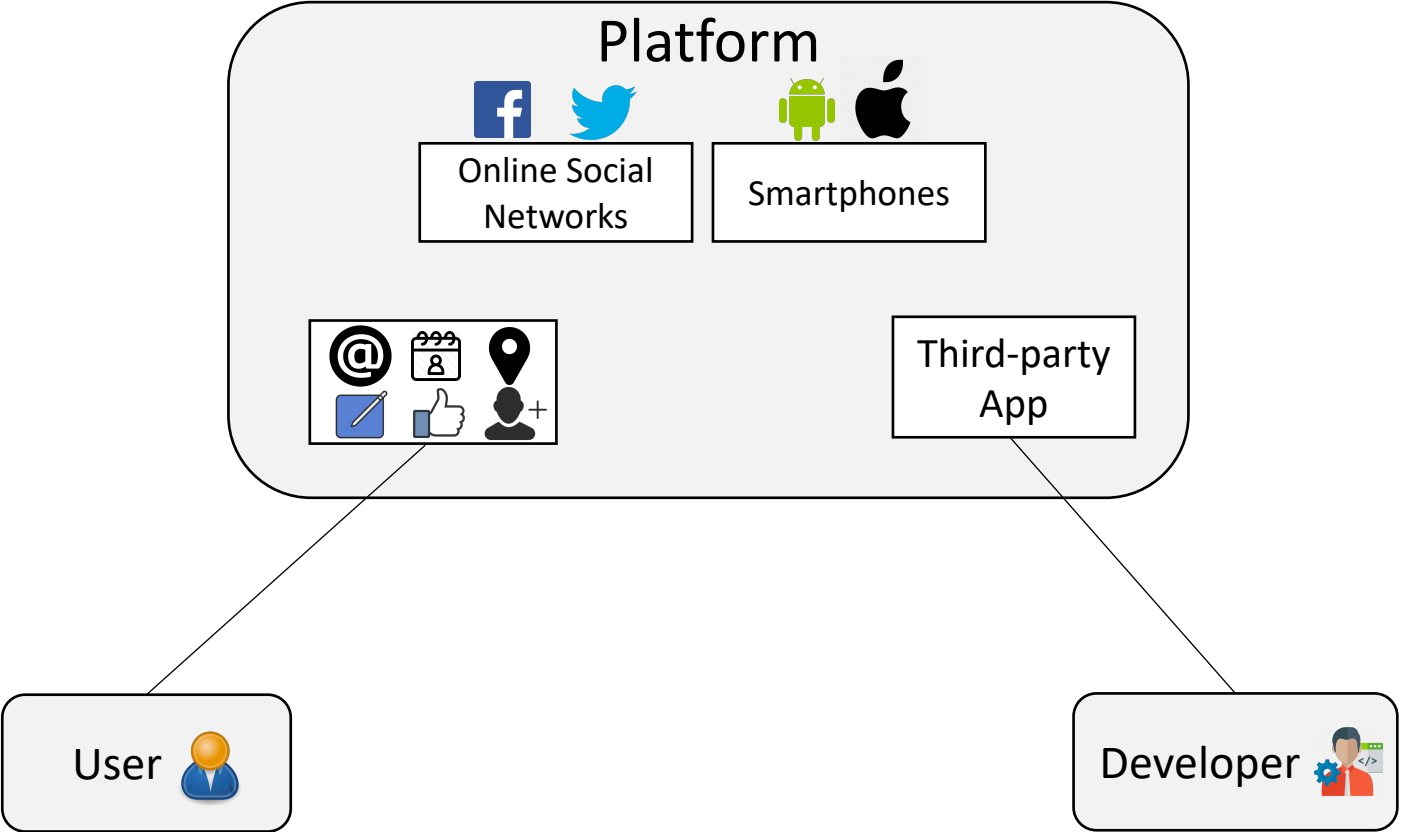# Characterizing Harms of Incentivized Advertising on Google Play
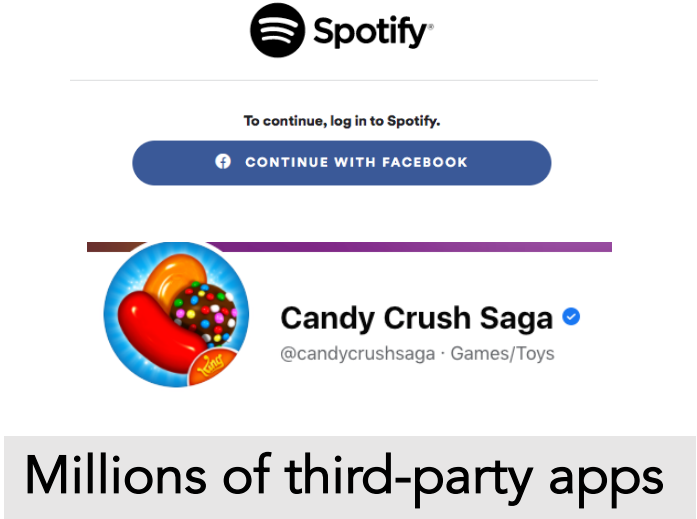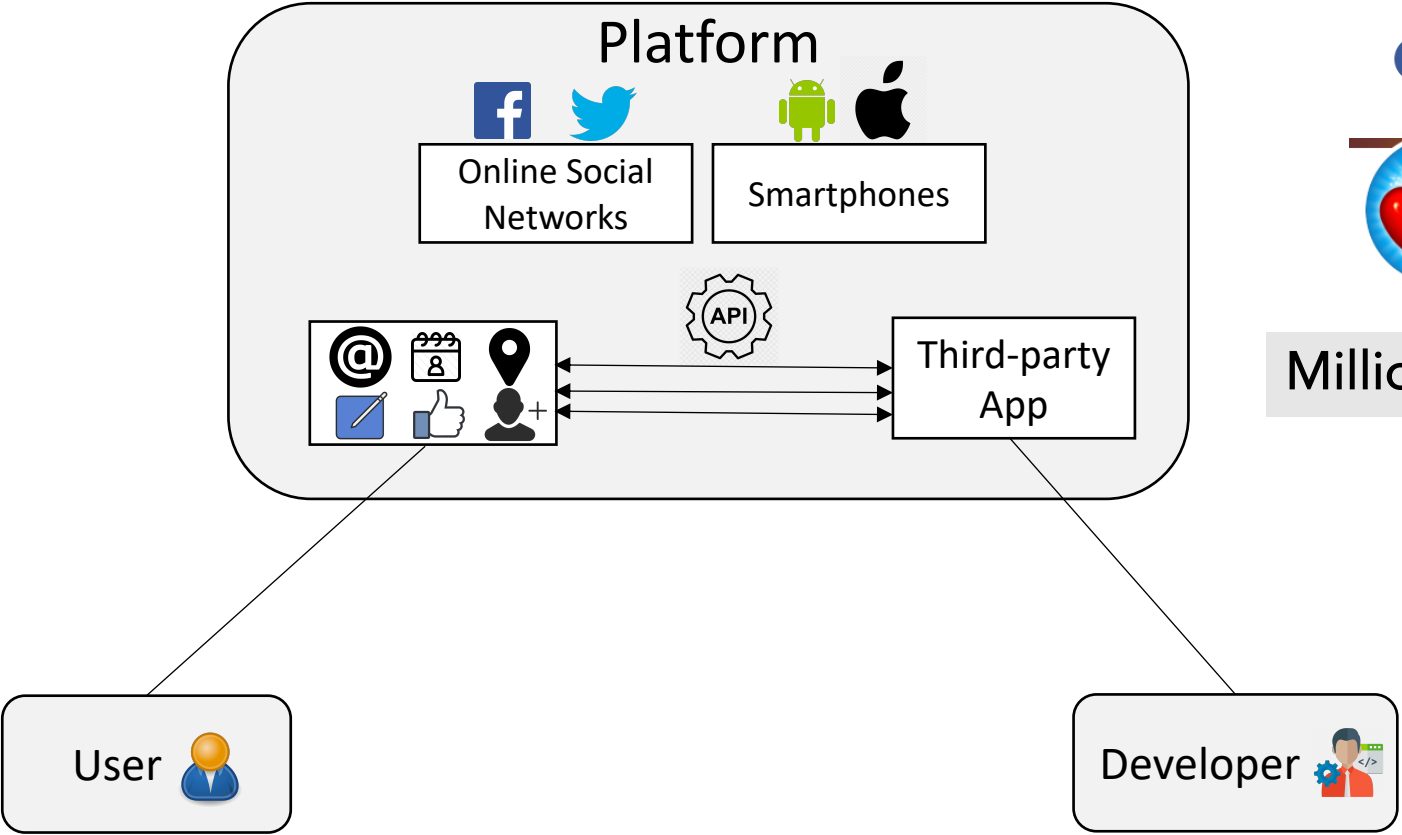
Zubair Shafiq

ZUBAIR@UCDAVIS.EDU | WEB.CS.UCDAVIS.EDU/~ZUBAIR/

UCDAVIS
UNIVERSITY OF CALIFORNIA

Third-party Apps

Third-party Apps

Platform

Online Social Networks

Smartphones

API

Third-party App

User

Developer

Millions of third-party apps

Spotify

To continue, log in to Spotify.

CONTINUE WITH FACEBOOK

Candy Crush Saga
@candycrushsaga · Games/Toys
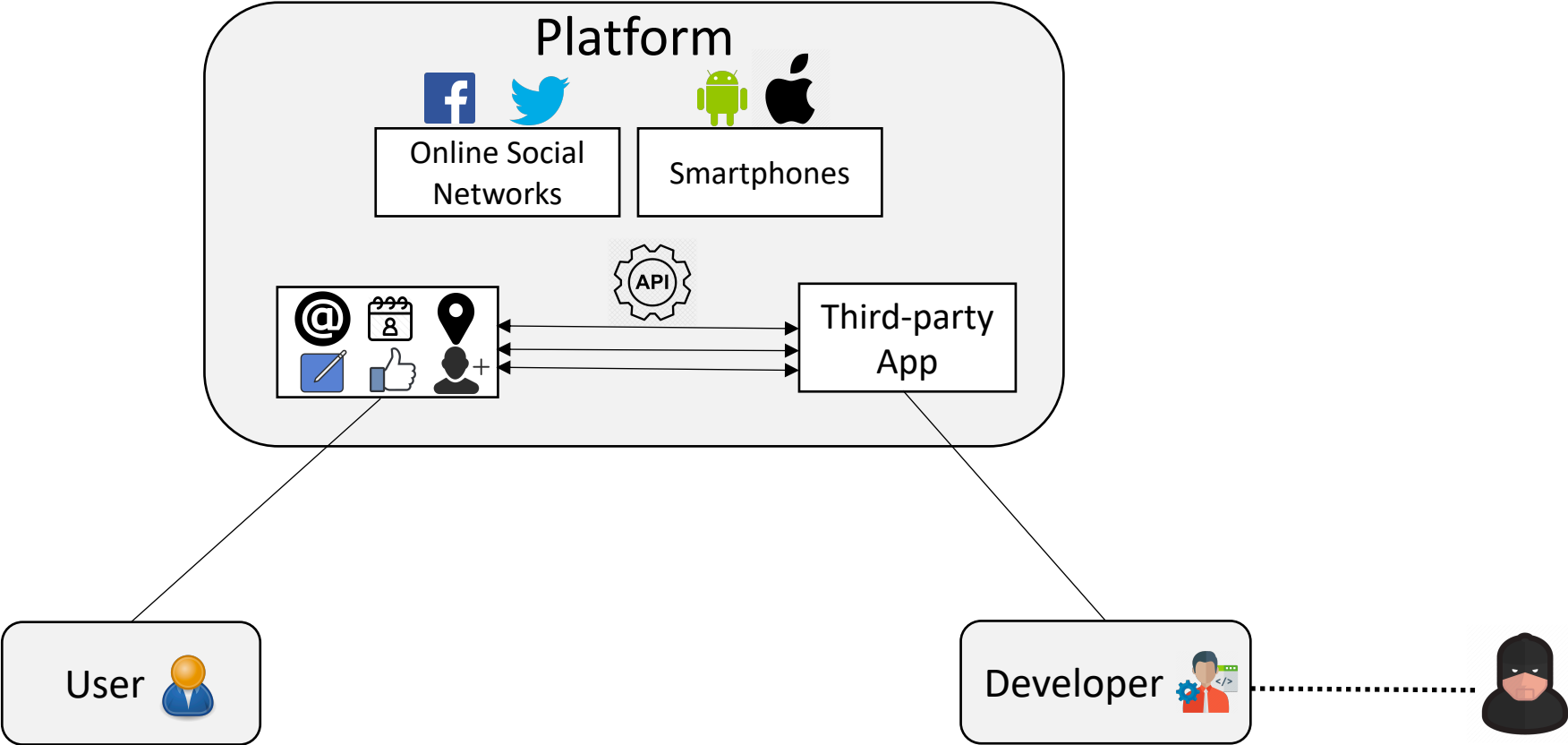
Abuse of Third-party Apps

Abuse of Third-party Apps

Reputation fraud

Twitter cuts off API access to follow/unfollow spam dealers

Instagram will soon start cracking down on accounts that use third-party apps to dole out fake likes and followers
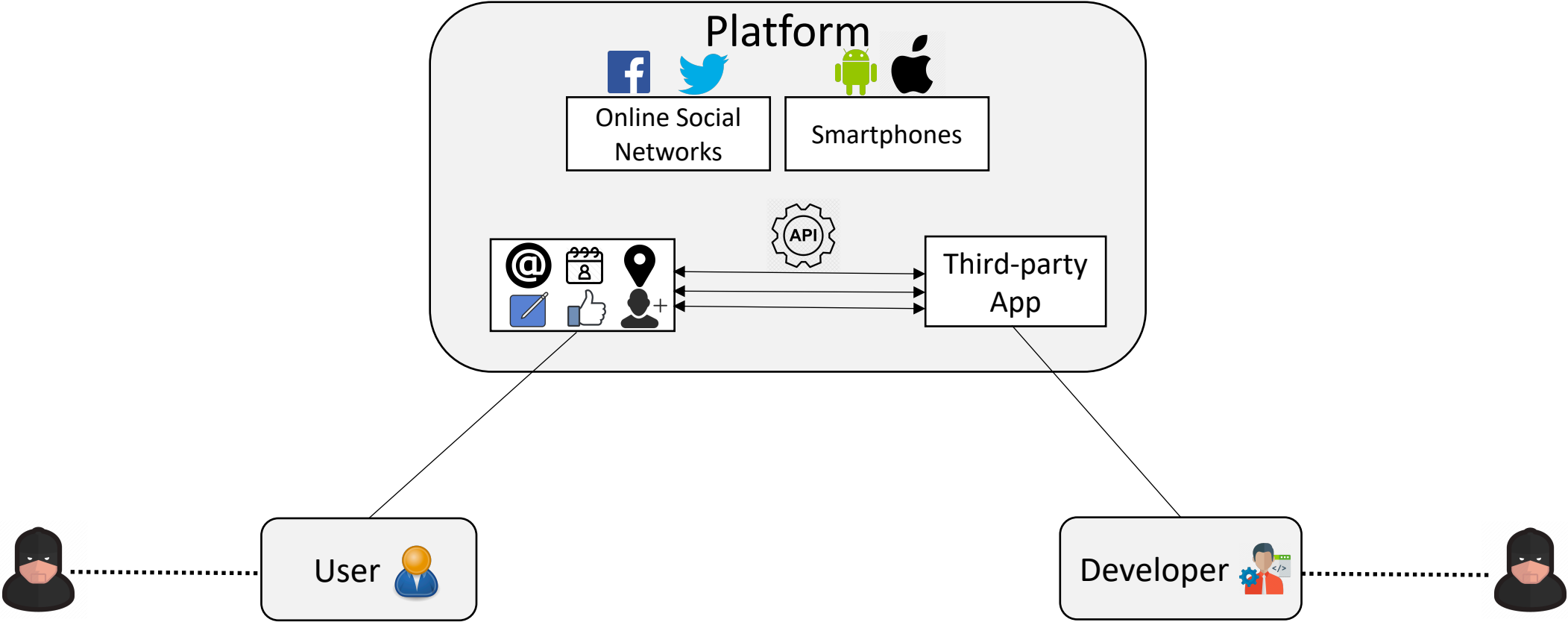
Privacy/Data breaches

The Cambridge Analytica Files

Revealed: 50 million Facebook profiles harvested for Cambridge Analytica in major data breach

The data was collected through an app called thisisyourdigitallife, built by academic Aleksandr Kogan, separately from his work at Cambridge University. Through his company Global Science
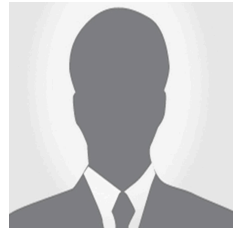
Today's Talk

Understanding Incentivized Mobile App Installs on Google Play Store

Shehroze Farooqi   Álvaro Feal   Tobias Lauinger   Damon McCoy   Narseo Vallina-Rodriguez

ACM Internet Measurement Conference (IMC 2020)

Mobile App Ecosystem

Developers create a variety of engaging mobile apps

Popular app stores

App store metrics

| Install counts | Visibility in top charts |

User engagement metrics

| Registrations | Session lengths |

Monetization/Revenue

| In-app ads | In-app purchases |

| Investor funding | Stock trading |

Mobile App Ecosystem

Developers create a variety of engaging mobile apps

Popular app stores

App store metrics

Increasing competition nts

Visibility in top charts

User engagement metrics

Registrations

Session lengths

Mobile app install advertising campaigns

Monetization/Revenue

In-app ads

In-app purchases

Investor funding

Public stocks

Mobile App Install Campaigns

Traditional (non-incentivized) mobile app install campaigns

    Find interested users

Incentivized mobile app install campaigns

    Pay users to install the app

    Users may not be really interested in the app

Cost of install is high

Considerably cheaper than non-incentivized

Incentivized Mobile App Install Campaigns

Install Counts

"Install App &Open only."

User Registrations

"Install App & Register an Account."

Manipulate app store's metrics (e.g., Install counts, visibility in top charts)

Usage metrics

"Install App & Reach Level 13."

Deceive investors to raise funding

Monetize artificial user engagement through ads

Revenue metrics

"Install App & make any purchase of $1."

Incentivized Installs have a bad reputation

Potentially fake engagement from uninterested users

Violation of app store policies

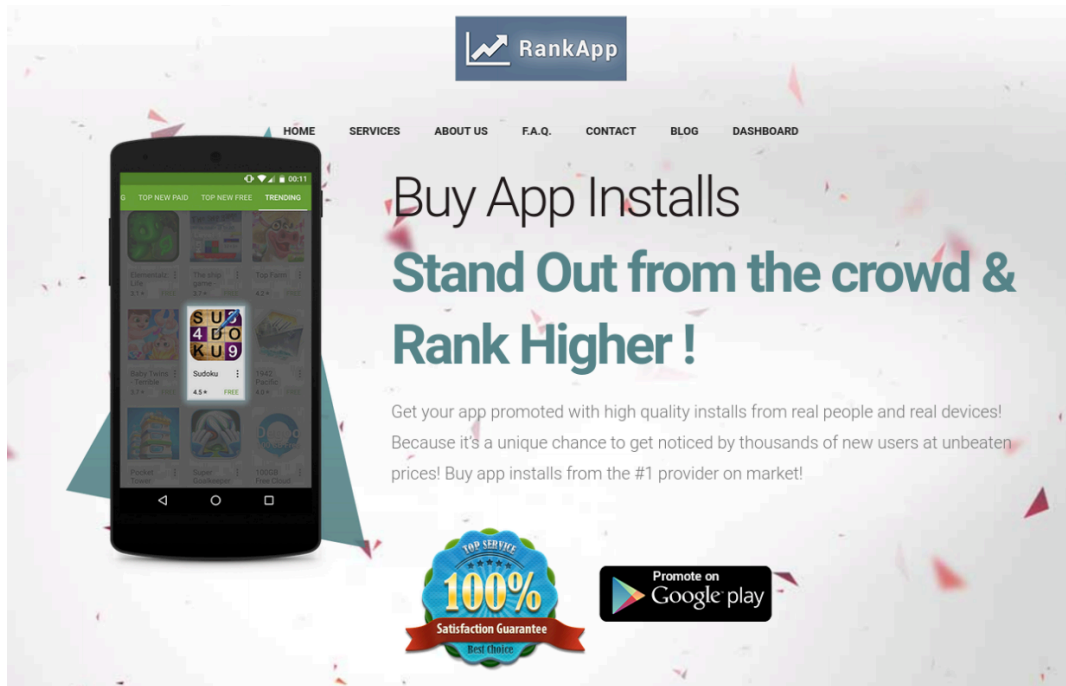　　　　Manipulation of app store metrics

Apple App Store banned them

Google Play Store does not completely ban them

App Store

Apple Clamps Down On Incentivized App Downloads

Google Play

"We've observed instances where incentivized installs are utilized solely to manipulate the placement of apps […] **we also recognize that incentivized installs can be a legitimate user acquisition channel for some developers**"

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AdscendMedia

Monetization ▾   Advertisers   Fraud Prevention   About   Log In   Get Started

Meet Our Exclusive Solutions:
Built for Superior Monetization & Brand Engagement
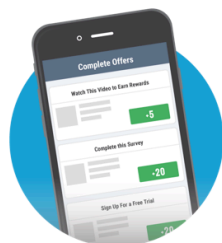
Offer Wall

Users choose to earn rewards from their favorite apps, games, and websites by completing quick actions, like downloading apps or watching videos.

Market Research

To earn more rewards, users complete a short profile and then receive targeted surveys based on their lifestyle and demographic makeup.

Owned & Operated Property

With high-quality in stream video and display, HideoutTV delivers superior creator engagement, brand engagement, and user monetization via a rewarding model.

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Outline

Understanding the ecosystem of Incentivized mobile app Installs

Effectiveness of existing Google Play Store's defenses
          Purchase incentivized installs

Impact of incentivized installs
          Monitoring infrastructure to identify incentivized install campaigns
          Characterize incentivized install campaigns
          Measuring Impact

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Incentivized Install Ecosystem
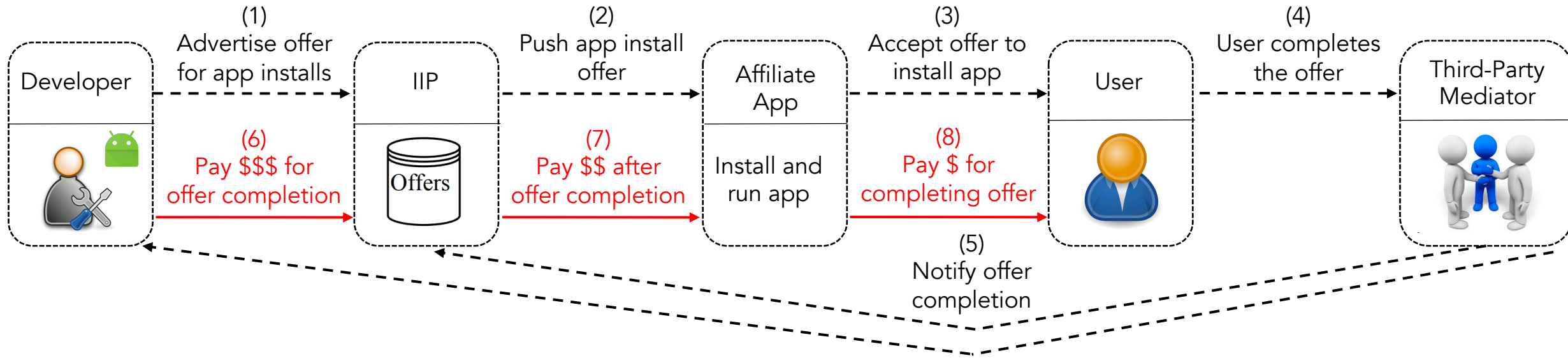
Incentivized Install Ecosystem - Developer

	(1) Advertise offer for app installs		(2) Push app install offer		(3) Accept offer to install app		(4) User completes the offer	

Developer	IIP	Affiliate App	User	Third-Party Mediator
	Offers	Install and run app		

(6) Pay $$$ for offer completion

(7) Pay $$ after offer completion

(8) Pay $ for completing offer

(5) Notify offer completion

No Activity	→	Only install an app

Activity	→	Perform additional tasks

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Incentivized Install Ecosystem - IIP

Developer → (1) Advertise offer for app installs → **IIP** → (2) Push app install offer → **Affiliate App** → (3) Accept offer to install app → **User** → (4) User completes the offer → **Third-Party Mediator**

IIP: Offers

Affiliate App: Install and run app

(6) Pay $$$ for offer completion

(7) Pay $$ after offer completion

(8) Pay $ for completing offer

(5) Notify offer completion

Incentivized Install Platform (IIP)

Observe a spectrum of IIPs based on our interactions

Vetted IIPs → More established developers

Unvetted IIPs → Less established developers

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Incentivized Install Ecosystem - IIP

(1)
Advertise offer
for app installs

(2)
Push app install
offer

(3)
Accept offer to
install app

(4)
User completes
the offer

Developer

IIP

Offers

Affiliate
App

Install and
run app

User

Third-Party
Mediator

(6)
Pay $$$ for
offer completion

(7)
Pay $$ after
offer completion

(8)
Pay $ for
completing offer

(5)
Notify offer
completion
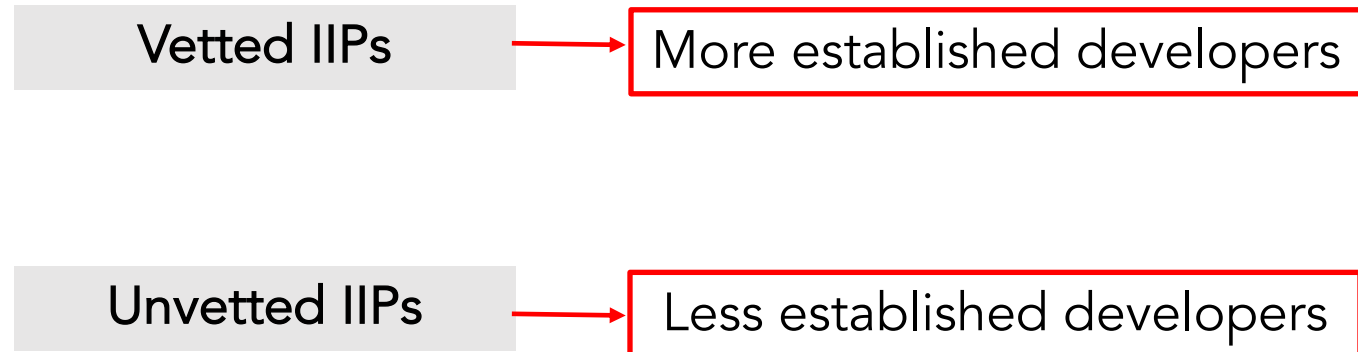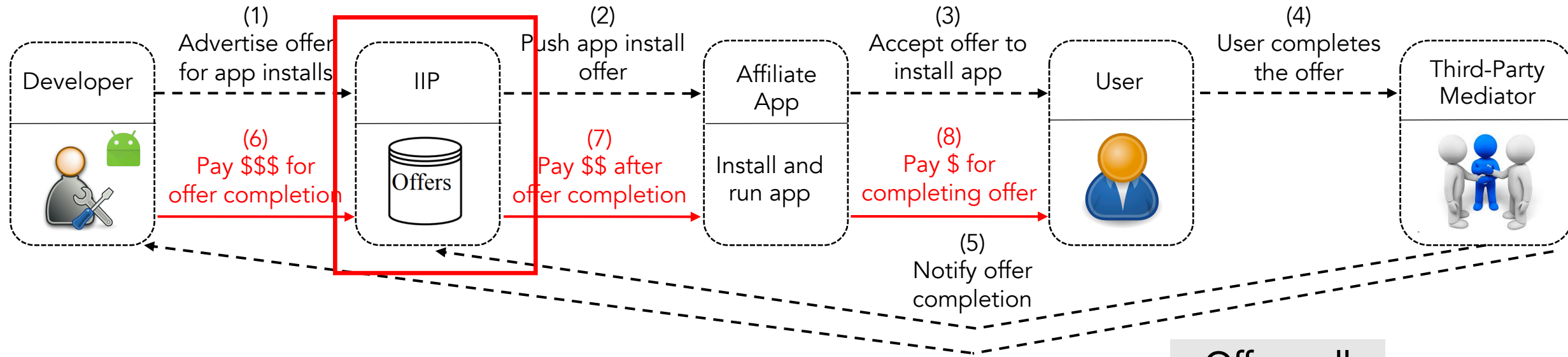
Incentivized Install Platform (IIP)

Aggregate offers from developers

Display list of offers in an offer wall

Offer wall

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Incentivized Install Ecosystem

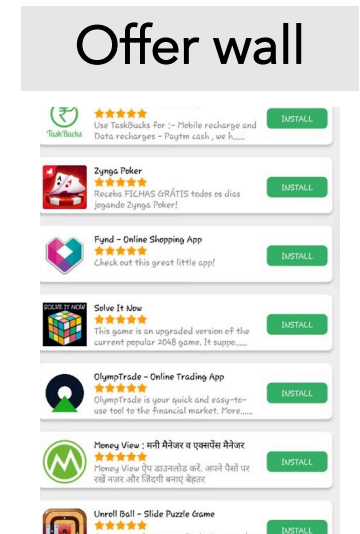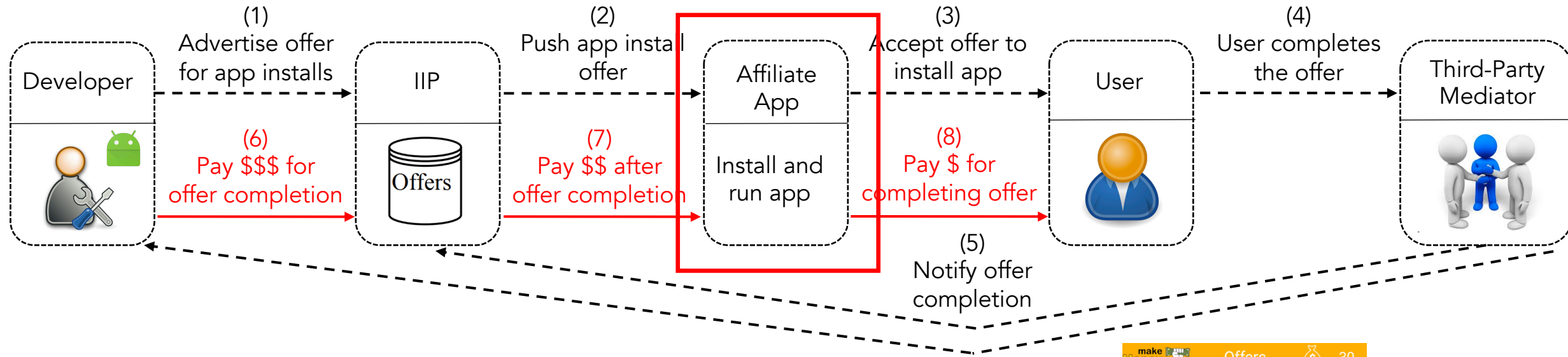## Affiliate App

Large user base

Accessed by users of affiliate apps

Incentivized Install Ecosystem

(1) Advertise offer for app installs

(2) Push app install offer

(3) Accept offer to install app

(4) User completes the offer

(5) Notify offer completion

(6) Pay $$$ for offer completion

(7) Pay $$ after offer completion

(8) Pay $ for completing offer

Developer

IIP — Offers

Affiliate App — Install and run app

User

Third-Party Mediator
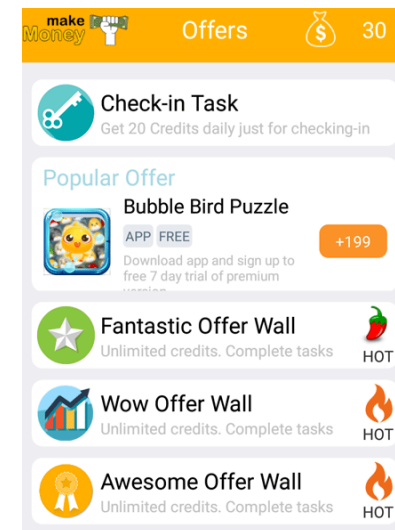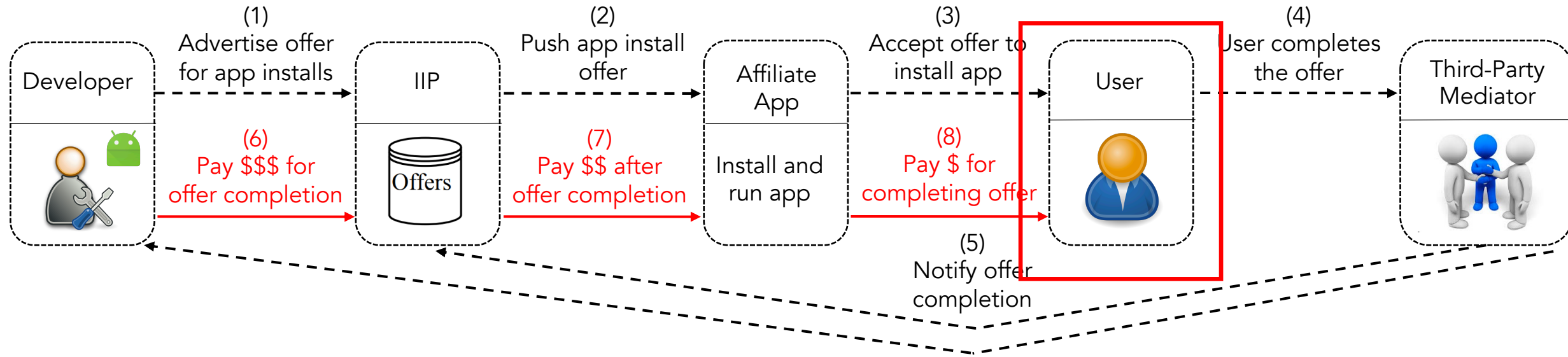
User

Likely crowd workers

Outline

Understanding the ecosystem of Incentivized mobile app Installs

Effectiveness of existing Google Play Store's defenses
> **Purchase incentivized installs**

Impact of incentivized installs
> Monitoring infrastructure to identify incentivized install campaigns
> Characterize incentivized install campaigns
> Measuring Impact

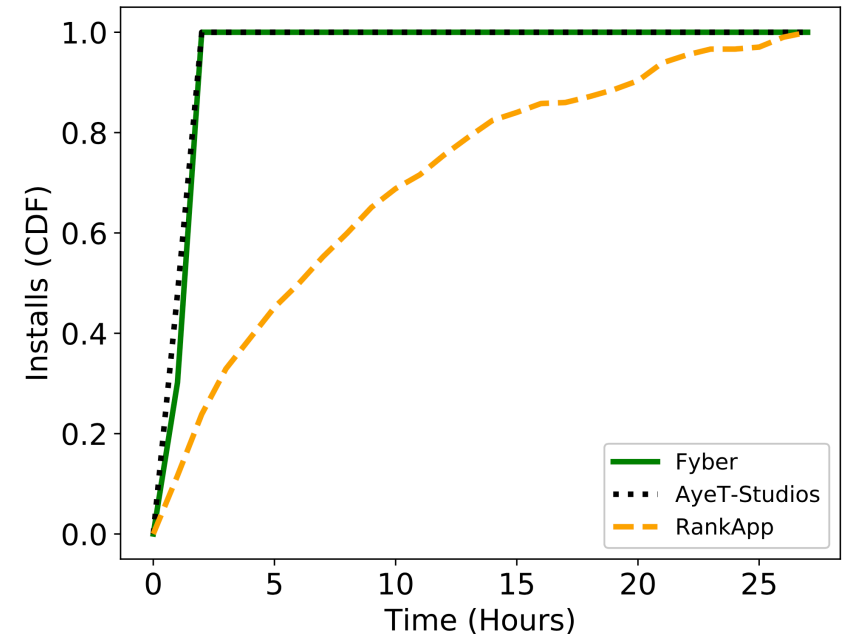# Purchase Incentivized Installs

Developed and published a honey mobile app on Google Play Store

Purchased 500 incentivized installs from three IIPs

Increased the public install count of our honey app

Google Play Store's defenses failed to detect incentivized installs

Users who installed these apps looked like bots or crowd workers

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Monitoring Infrastructure
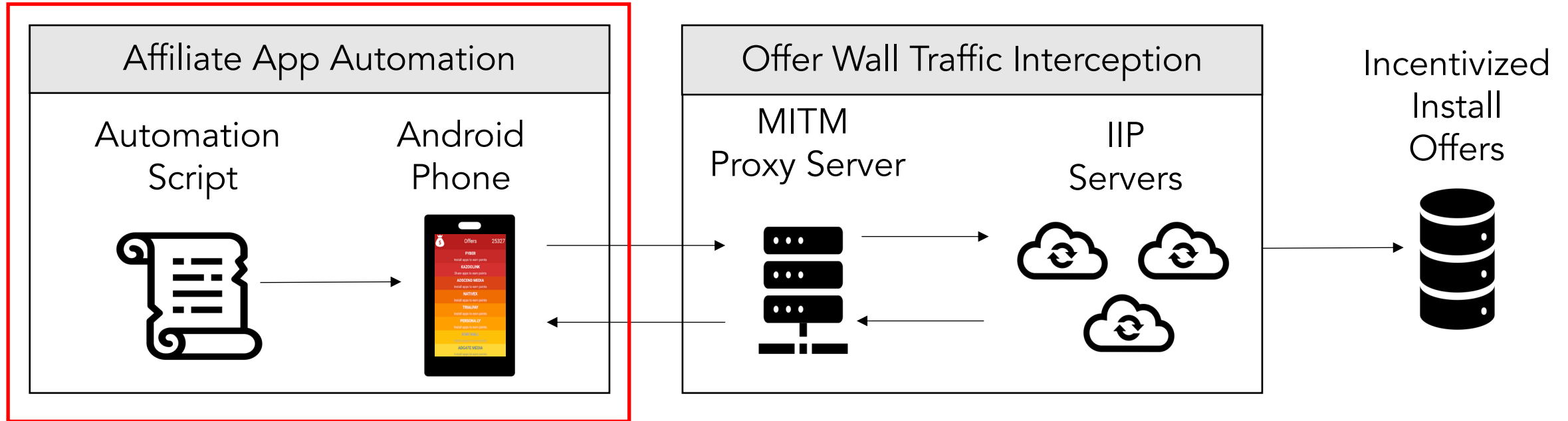
Monitoring Infrastructure
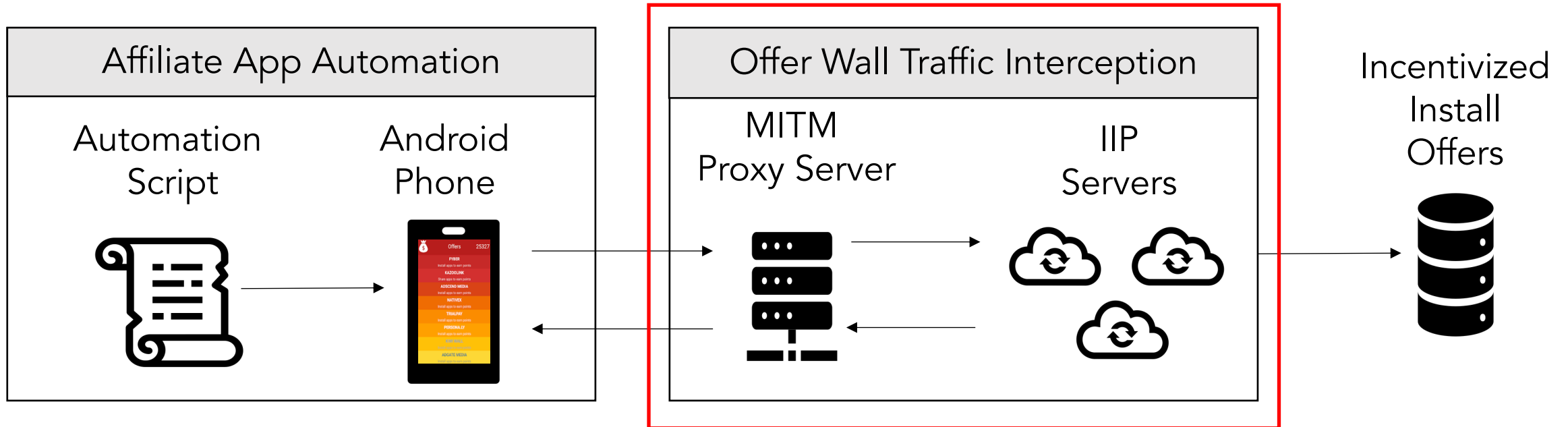
Filter HTTP responses that contain offer walls

Typically JSON format

Monitoring Infrastructure

Affiliate App Automation

Automation Script   Android Phone

Offer Wall Traffic Interception

MITM Proxy Server   IIP Servers

Incentivized Install Offers
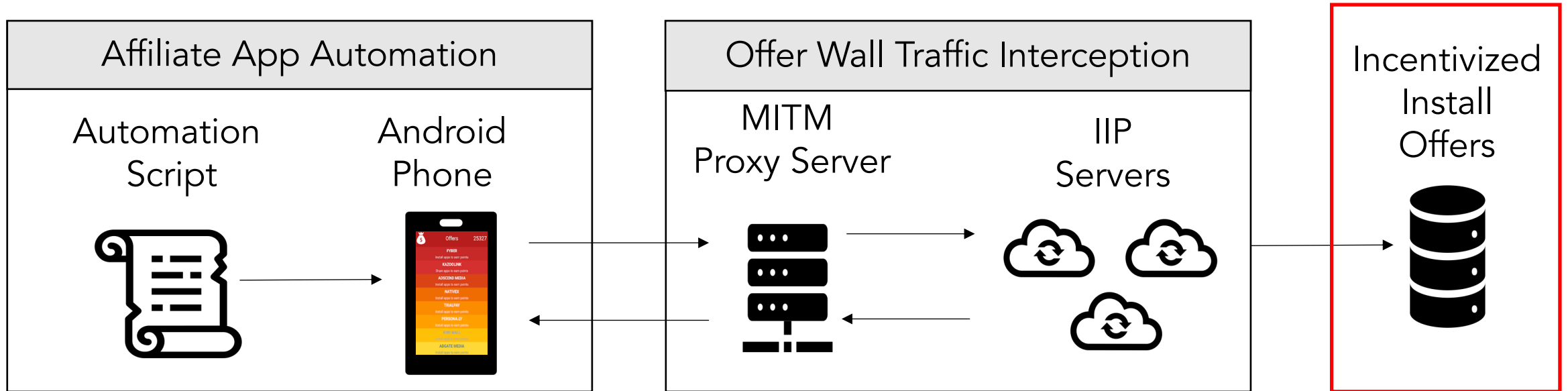
Offer's Metadata

App's name

Offer description

Offer payout

Monitoring Infrastructure

Affiliate App Automation

Automation Script

Android Phone

Offer Wall Traffic Interception

MITM Proxy Server

IIP Servers

Incentivized Install Offers

Google Play Store Crawler

Top charts

Developer info
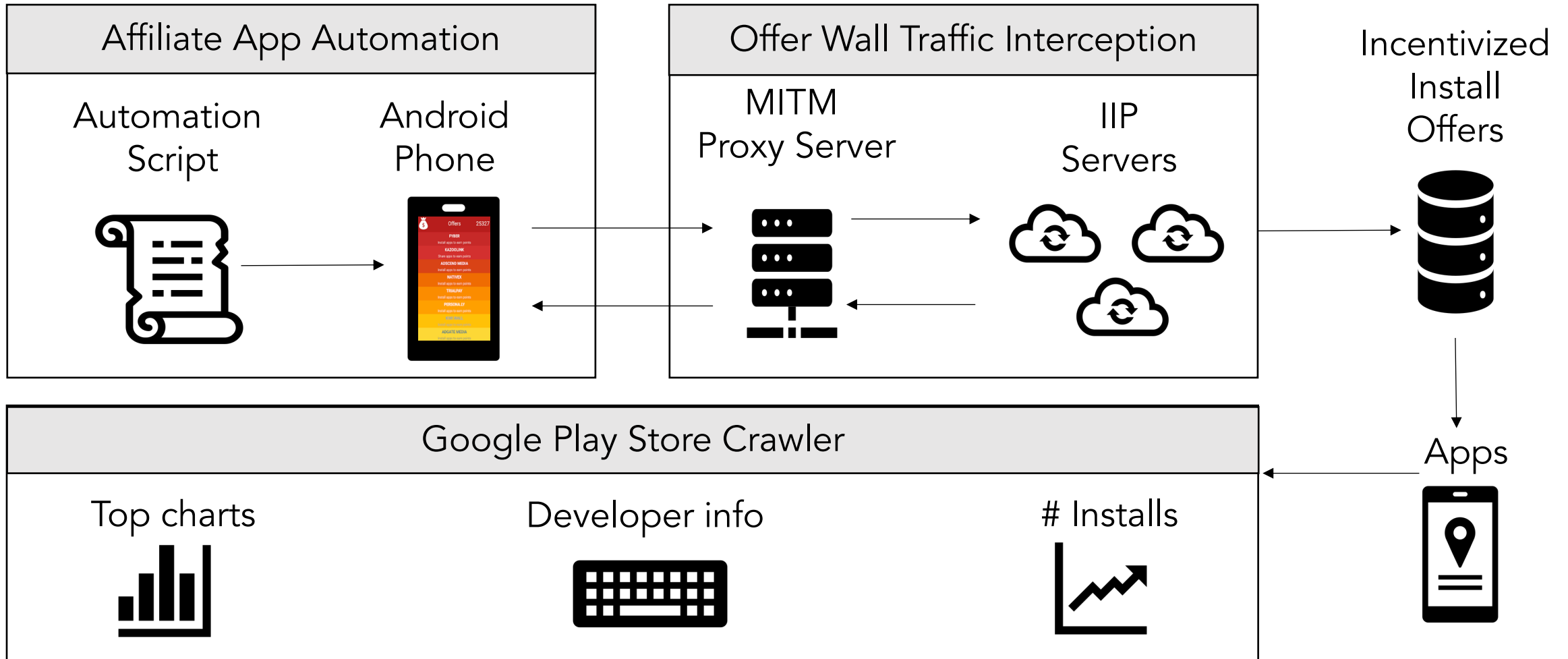
Installs

Apps

Monitoring Infrastructure

Monitored from March 2019 to June 2019

Automated 8 affiliate apps

Most popular affiliate app had 10M+ install counts

5 vetted IIPs

2 unvetted IIPs

2,126 unique incentivized installs offers from 922 unique apps

Characterizing Incentivized Install Campaigns

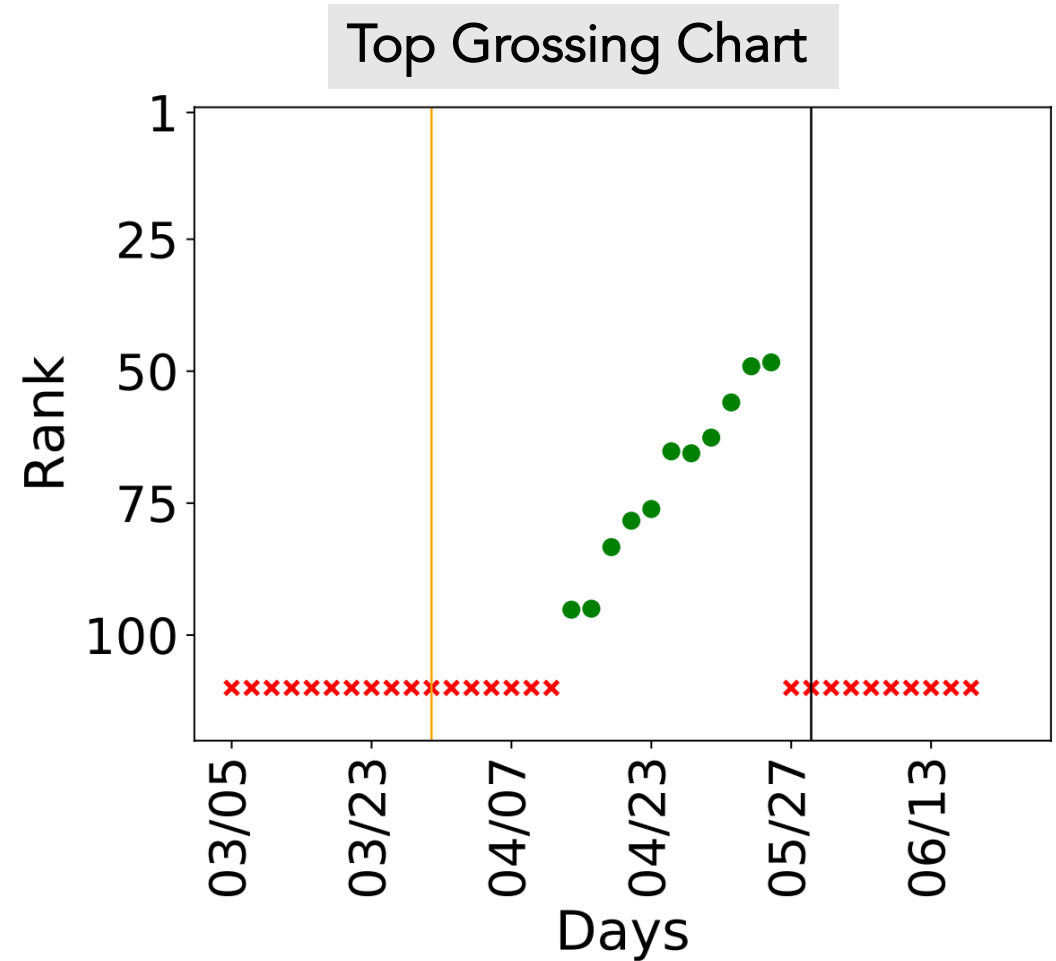| Characteristic	Vetted	Unvetted
Median Install Count	1,000,000+	1,000+
Median Payout	$0.45	$0.04
"No activity" offers	29%	91%
"Activity" offers	71%	9%

dichotomy between vetted & unvetted IIPs

Measuring Impact

Impact on app store metrics

　　　Increase in install counts

　　　Appearance in top charts

Top Grossing Chart

Measuring Impact

Impact on app store metrics

  Increase in install counts

  Appearance in top charts

Impact on investor funding

  Crunchase.com database

Incentivized install campaign from 12th March to 27th March

Password manager Dashlane closes on $30M, adds former Spotify CMO to board

Sarah Perez   @sarahintampa   /   11:39 am CDT   • April 12, 2019

Incentivized install campaign from 7th May to 14th May

Password manager Dashlane raises $110M in Series D, adds CMO

Zack Whittaker   @zackwhittaker   /   11:27 am CDT   May 30, 2019

Measuring Impact

Impact on app store metrics

       Increase in Install Counts

       Appearance in top charts

Impact on investor funding

       Crunchase.com database

Monetization strategies

       Arbitrage

       Advertisement

Experimental Setup

Baseline apps

    Lumen Privacy Monitor App [Razaghpanah '15]

    Sampled 300 apps

    Apps from all types of popularities

Chi-squared test of independence

    Statistical significance level of 0.05

    Perform two separate tests i.e., [**Vetted vs. Baseline**] and [**Unvetted vs. Baseline**]

Lumen Privacy Monitor

Int. Computer Science Institute-UC Berkeley   Tools

E Everyone

⚠ You don't have any devices.

You can share this with your family. Learn more about Family Library

Results

	Vetted	Unvetted
Increase in install counts	$\chi^2 = 26.0$, $p = 3.378e^{-7}$	$\chi^2 = 39.9$, $p = 0.000$
Appearance in top charts	$\chi^2 = 5.43$, $p = 0.02$	$\chi^2 = 0.22$, $p = 0.64$
Investor funding	$\chi^2 = 4.7$, $p = 0.03$	$\chi^2 = 2.8$, $p = 0.10$

* Green box indicates statistically significant correlation exists   ** Red box indicates failure to establish statistically significant correlation

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Responsible disclosure

Responsible Disclosure

Developers could be deceived/defrauded

Disclosed our findings to 137 popular apps with 5M+ installs

''**We aren't aware of an incentivized install campaign** for the [..] Incentivized install campaigns contradict our policy [..].''

'' Agencies sometimes misuse our company logo and links to our landing pages to create fraudulent ads [..] **Most are abusing their roles in the affiliate advertising marketplace to make quick sales** [..] Our team is always monitoring these types of practices to be able to block this type of campaign as soon as possible''

Responsible Disclosure

Disclosed our findings to Google

Summary

Incentivized installs can have negative impacts on app store and beyond

Investor funding

Potential violations of Google Play Store's policies

Lack of enforcement of existing Google Play Store's defenses

Concluding Remarks

Our measurements and infrastructure can help:
      Google Play Store to identify policy violations
      App developers to determine if they are being deceived
      Investors to determine if app developers are misleading them
      Consumer protection agencies to audit systemic fraud

Other harms of incentivized advertising
      Privacy of users

Emerging use of incentivized advertising
      In response to ad-blocking

Characterizing Harms of Incentivized Advertising on Google Play

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