Are these Ads Safe: Detecting Hidden Attacks through Mobile App-Web Interfaces

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Consider This…

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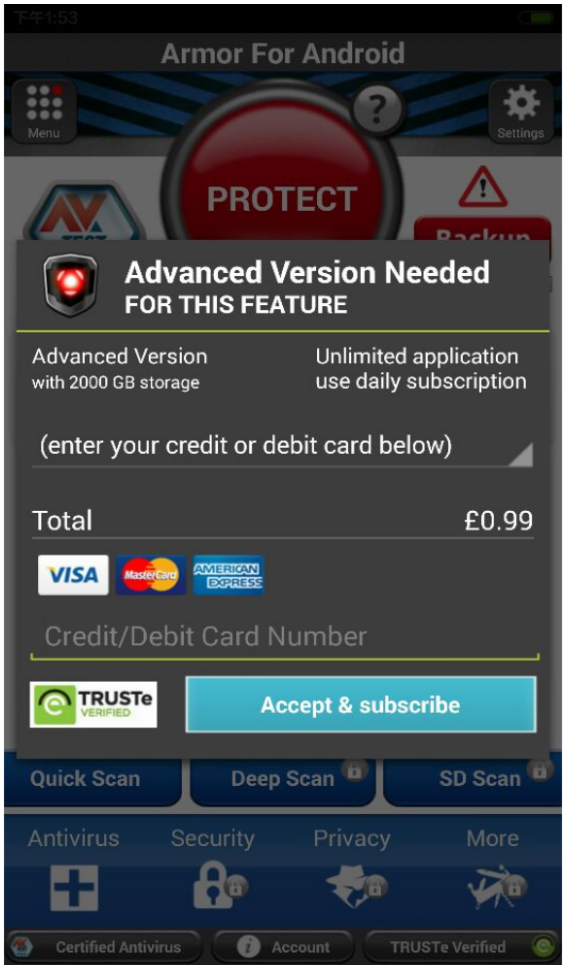

The Problem

- Enormous effort toward analyzing malicious applications
- App may itself be benign
  - But may lead to malicious content through links
- ***App-web interface***
  - Links inside the app leading to web-content
  - Not well-explored
- Types
  - Advertisements
  - Other links in app

Outline

- App-Web Interface Characteristics
- Solution
- Results
- Conclusion

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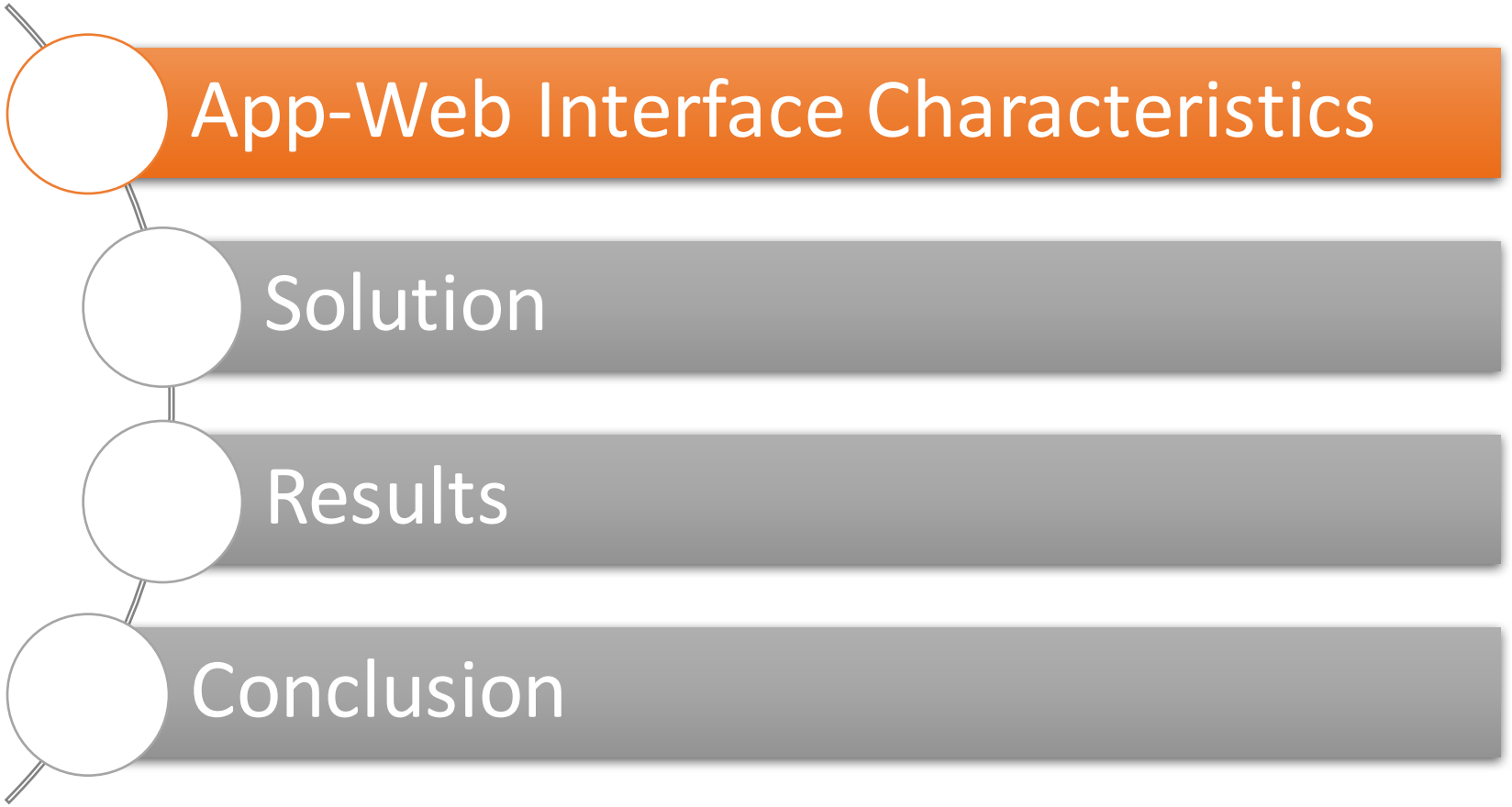
App-Web Interface Characteristics
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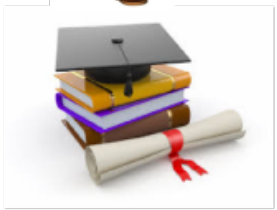
App-Web Interface Characteristics

- Can be highly dynamic
- A link may recursively redirect to another before leading to a final web page
- Links embedded in apps
  - Can be dynamically generated
  - Can lead to dynamic websites
- Advertisements
  - Ad libraries create links dynamically
  - Ad economics can lead to complex redirection chains

Advertising Overview



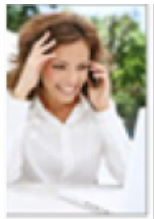
AdColony

admob

millennialmedia

友盟 UMENG

INMOBI

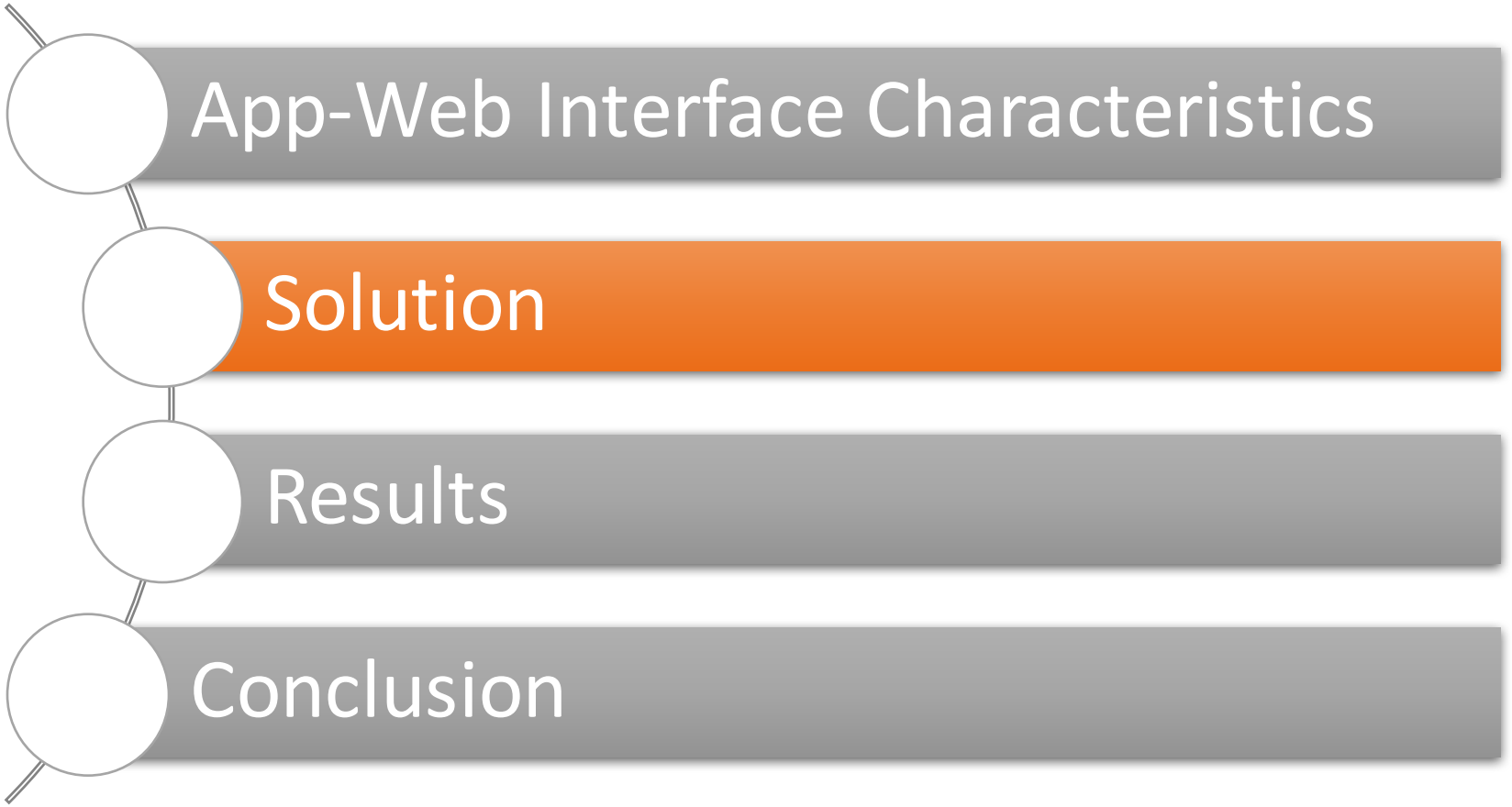


Advertisers | Ad networks | Apps / Developers | Users

Ad Networks

- Ad libraries act as the interface between apps and ad network servers
- Ad networks may interface with each other
  - Syndication – One network asks another to fill ad space
  - Ad exchange – Real-time auction of ad space
- App or original ad network may not have control on ads served

Outline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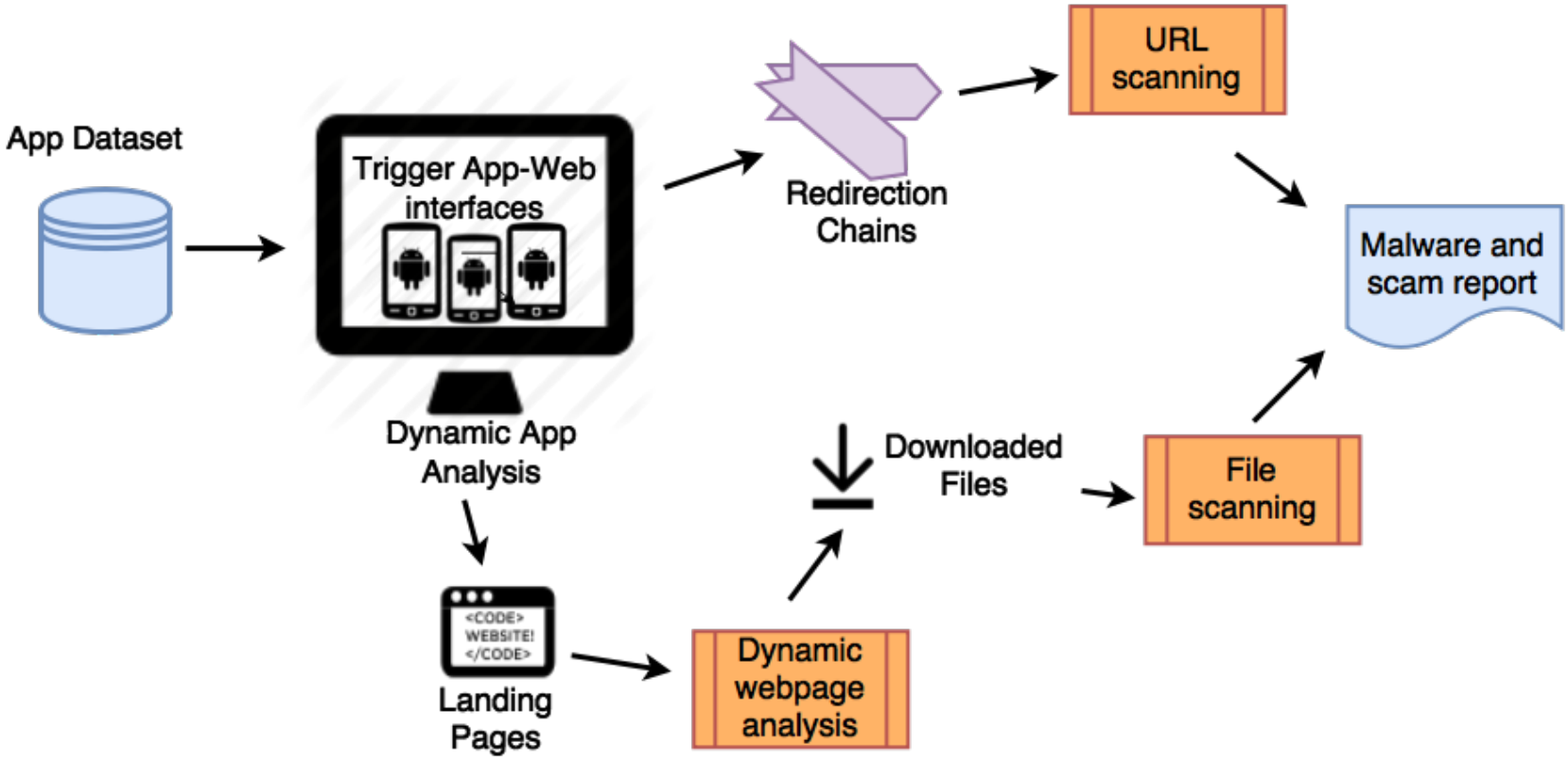
Solution Components

- **Triggering**: Interact with app to launch web links
- **Detection**: Process the results to identify malicious content
- **Provenance**: Identify the origin of a detected malicious activity
  - Attribute malicious content to domains and ad networks

Solution Architecture



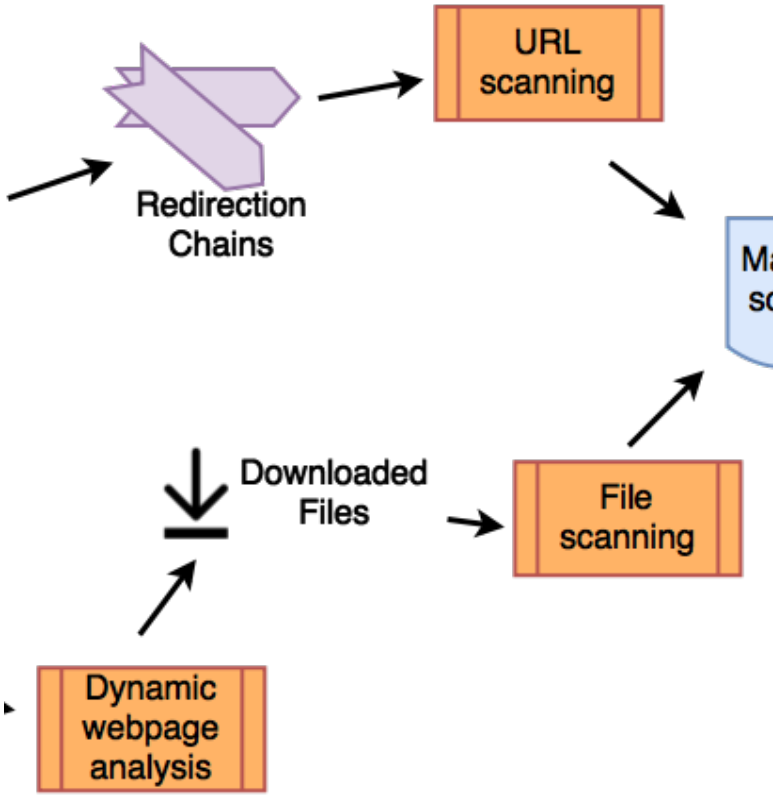
Triggering

- Use AppsPlayground[1]
  - A gray box tool for app UI exploration
  - Extracts features from displayed UI and iteratively generates a UI model
- A novel computer graphics-based algorithm for identifying buttons
  - See widgets and buttons as a human would

[1]Rastogi, Vaibhav, Yan Chen, and William Enck. "AppsPlayground: automatic security analysis of smartphone applications." In *Proceedings of the third ACM conference on Data and application security and privacy*, pp. 209-220. ACM, 2013.

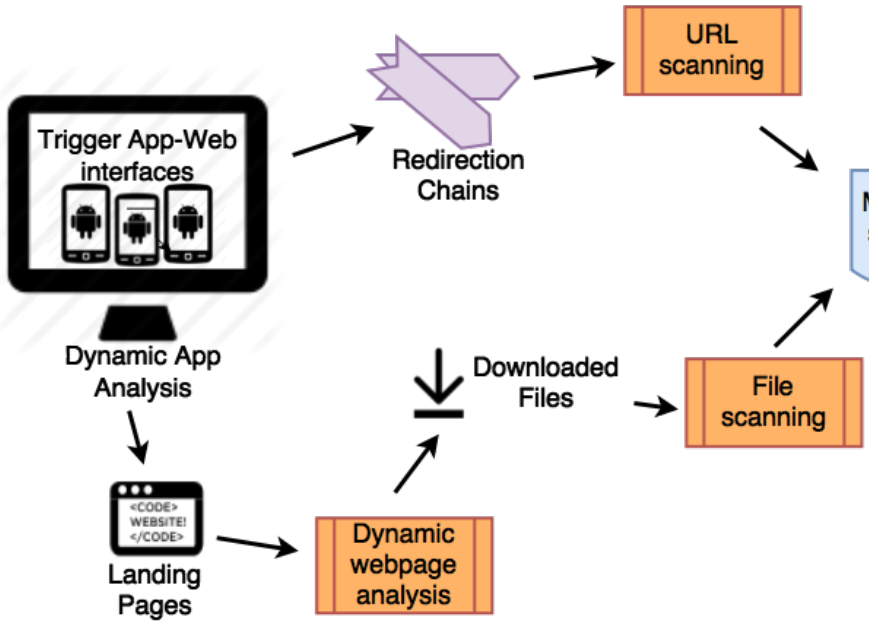
Detection

- Automatically download content from landing pages
- Use VirusTotal for detecting malicious files and URLs



Provenance

- How did the user come across an attack?
- Code-level attribution
  - App code
  - Ad libraries
    - **Identified 201 ad libraries**
- Redirection chain-level attribution
  - Which URLs led to attack page or content



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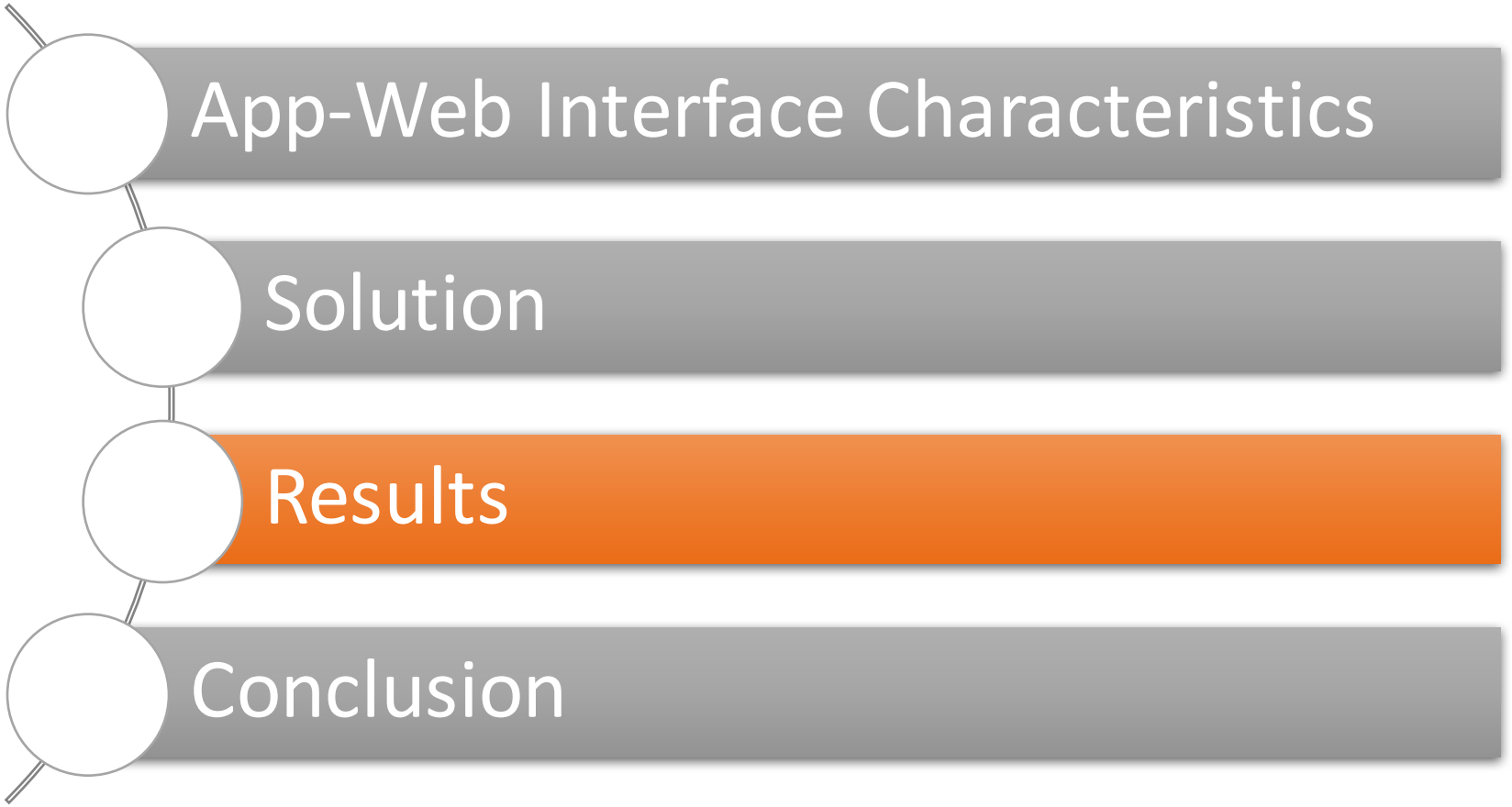
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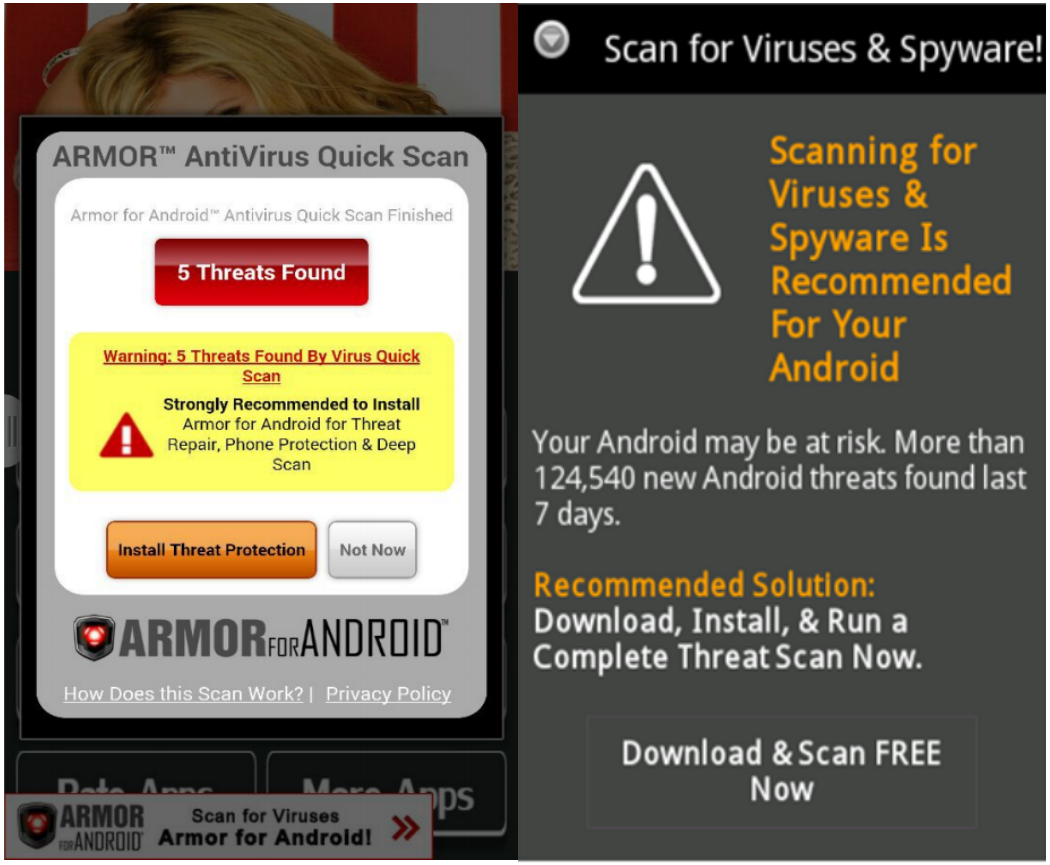
Results

- Deployments in US and China
- 600 K apps from Google Play and Chinese stores
- 1.4 M app-web links triggered
- 2,423 malicious URLs
- 706 malicious files

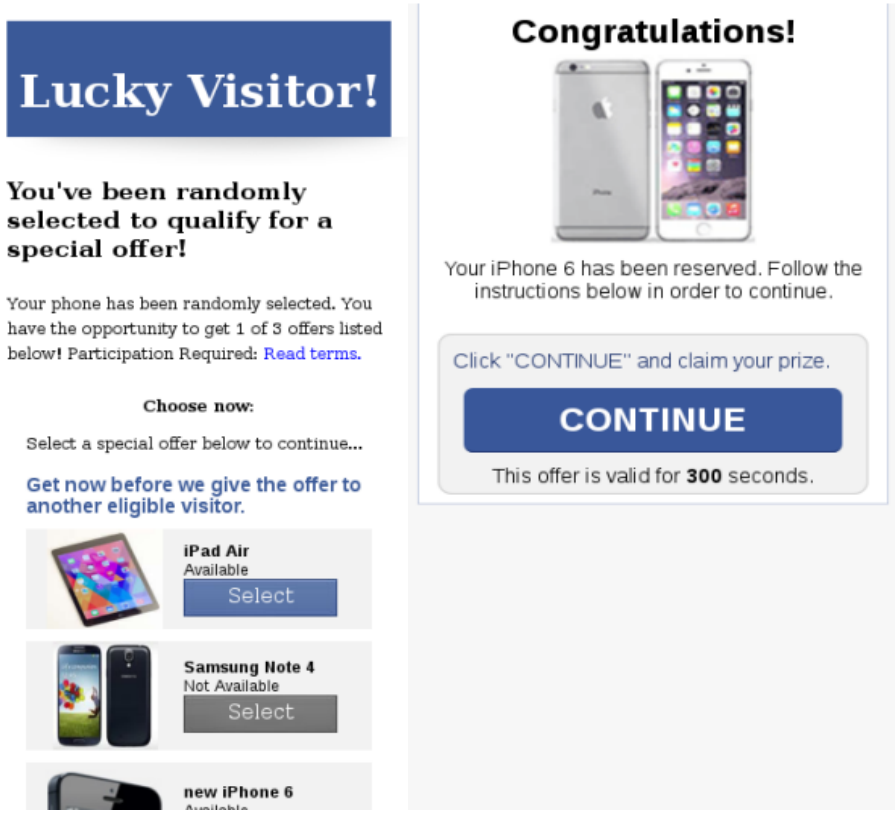
Case Study: Fake AV Scam

- Multiple apps, one ad network: Tapcontext
- Ad network solely serving this scam campaign
- Phishing webpages detected by Google and other URL blacklists about 20 days after we detected first instance



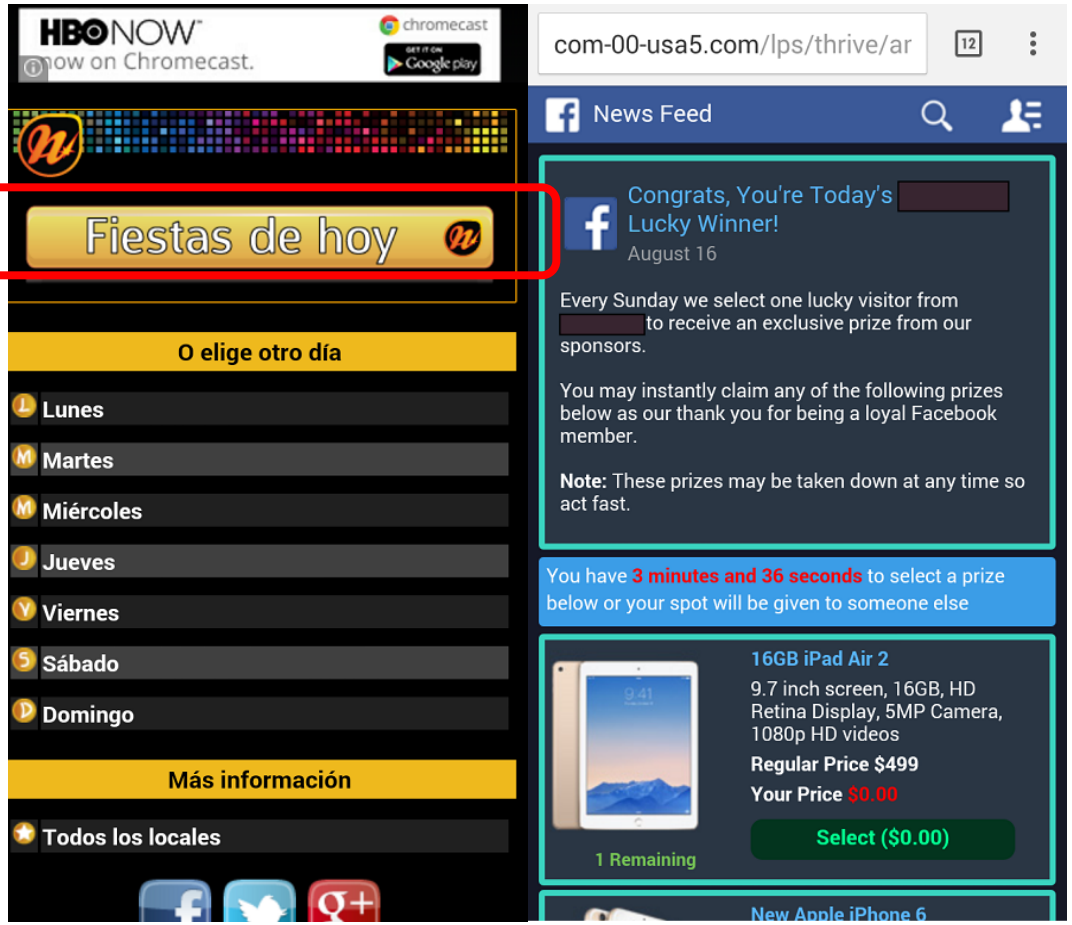
Case Study: Free iPad Scam

- Asked to give personal information without any return
- New email address receiving spam ever since
- Origins at Mobclix and Tapfortap
  - Ad exchanges
  - Neither developers nor the primary ad networks likely aware of this



Case Study: iPad Scam from static link

- Another Scam, this time through a static link embedded in app
- Link target opens in browser and redirects to scam
- Not affiliated with Facebook

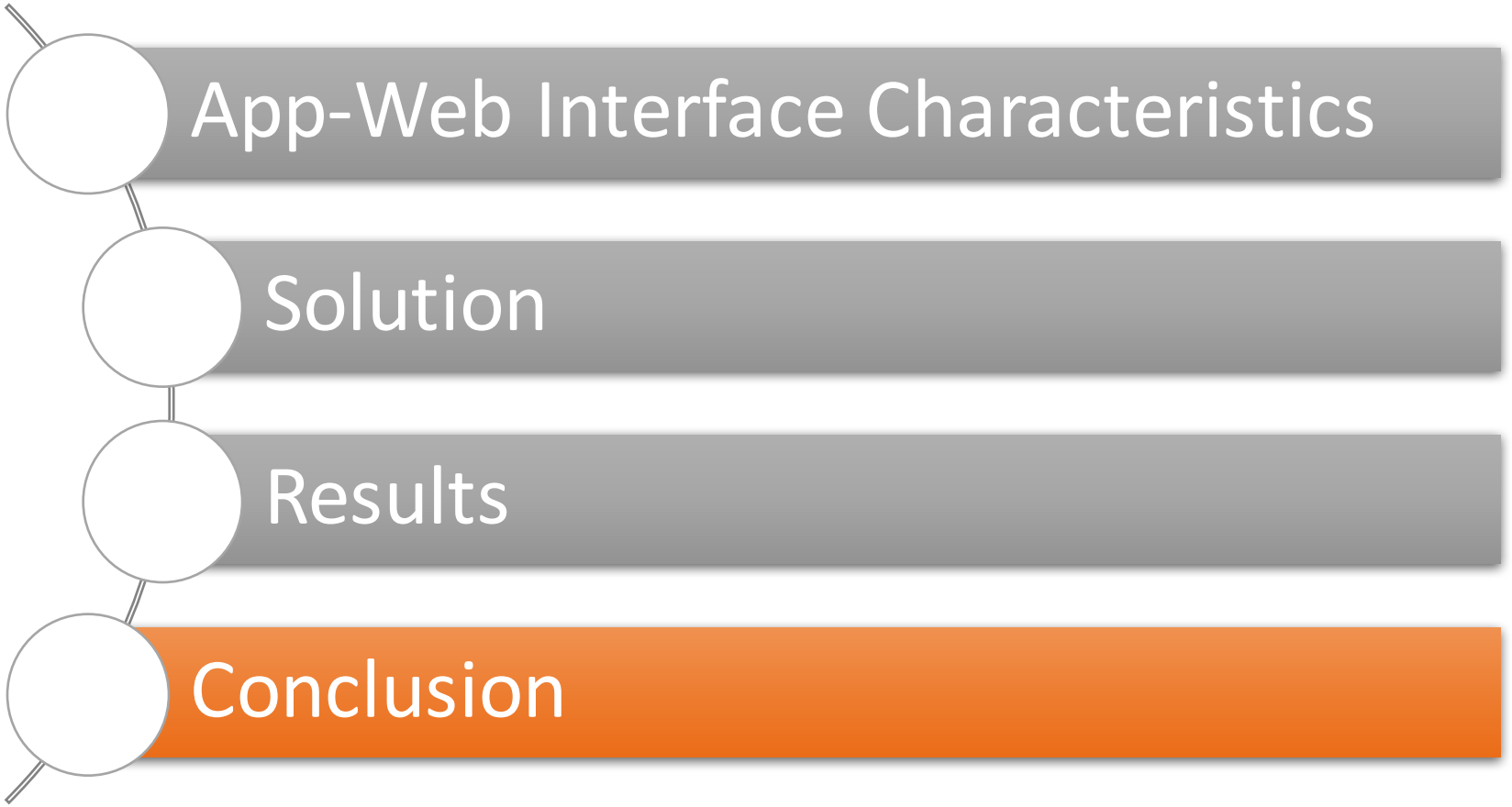


Case Study: SMS Trojan Video Player

Click on ad

- Ad from nobot.co.jp leads to download a movie player
- Player sends SMS messages to a premium number without user consent

Outline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Limitations

- Incomplete detection
  - Antiviruses and URL blacklists are not perfect
  - Our work DroidChameleon[2] shows this
- Incomplete triggering
  - App UI can be very complex
  - May still be sufficient to capture advertisements

[2]Rastogi, Vaibhav, Yan Chen, and Xuxian Jiang. "Catch me if you can: Evaluating android anti-malware against transformation attacks." *Information Forensics and Security, IEEE Transactions on* 9.1 (2014): 99-108.

Conclusion

- Benign apps can lead to malicious content
- Provenance makes it possible to identify responsible parties
- Can provide a safer landscape for users
  - Screening offending applications
  - Holding ad networks accountable for content
- Working with CNCERT to improve the situation

Future Work

- Speeding up collection of ads
- Goals of analyzing an order of magnitude more ads in shorter time

Software and Dataset

- Dataset of 201 ad libraries: http://bit.ly/adlibset

- New release of AppsPlayground: http://bit.ly/appsplayground

Thank you!