Not Your Average App: A Large-scale Privacy Analysis of Android Browsers

Amogh Pradeep, Álvaro Feal, Julien Gamba, Ashwin Rao, Martina Lindorfer, Narseo Vallina-Rodriguez, David R. Choffnes

Mobile Browsers as Web Browsers

Popular

- Over 58% of global website visits in 2022

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Handle sensitive browsing data

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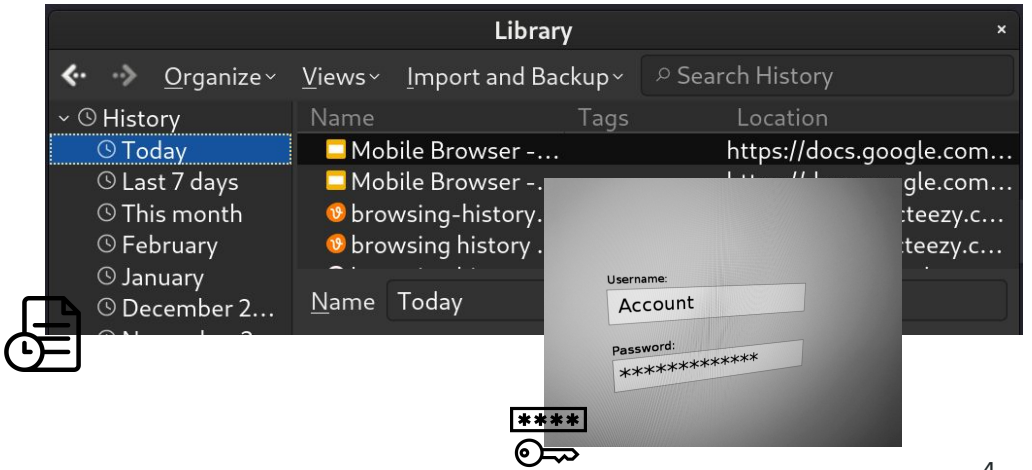
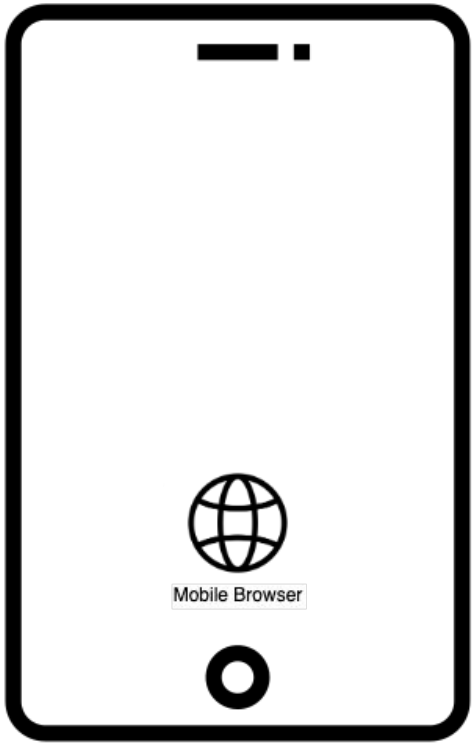
Popular

Handle sensitive browsing data

- Browsing history, logins, etc.

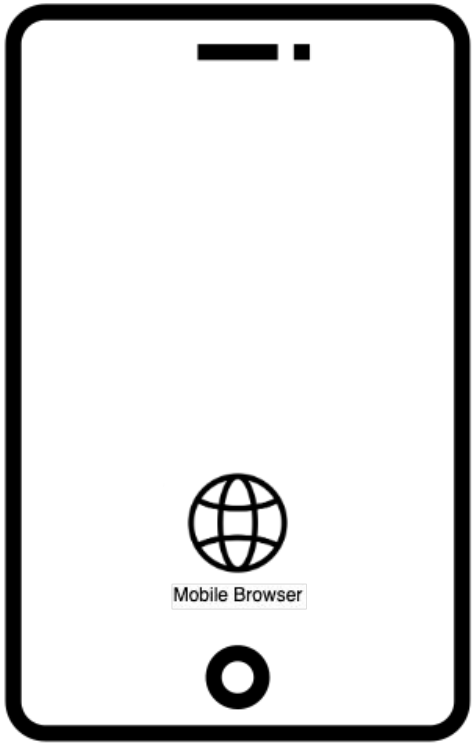


Mobile Browsers as Mobile Apps



Mobile Browsers as Mobile Apps

Can access mobile-specific sensitive user data



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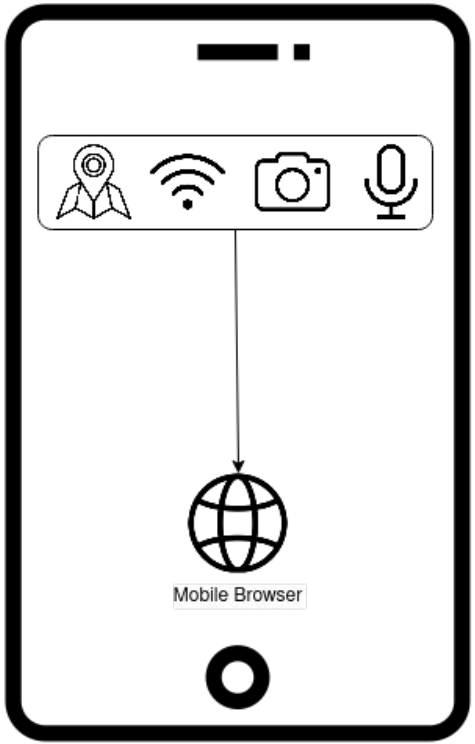


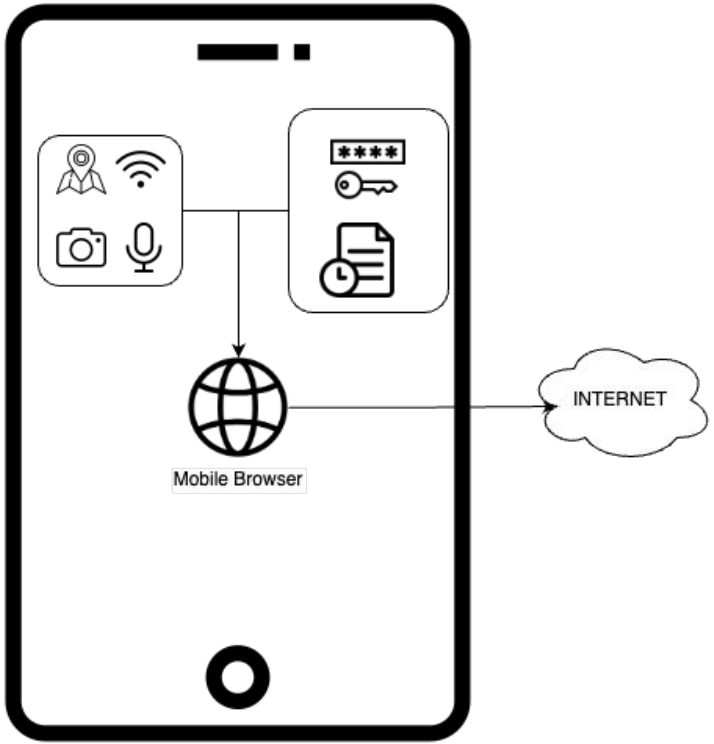
Mobile Browsers - Questions

How do mobile browsers **harm users?**

- Access mobile-specific user data
- Share data with web hosts
- Fail to implement security measures

How do mobile browsers **protect users?**

- User data
- Browsing the Internet



Harms - User Data Access

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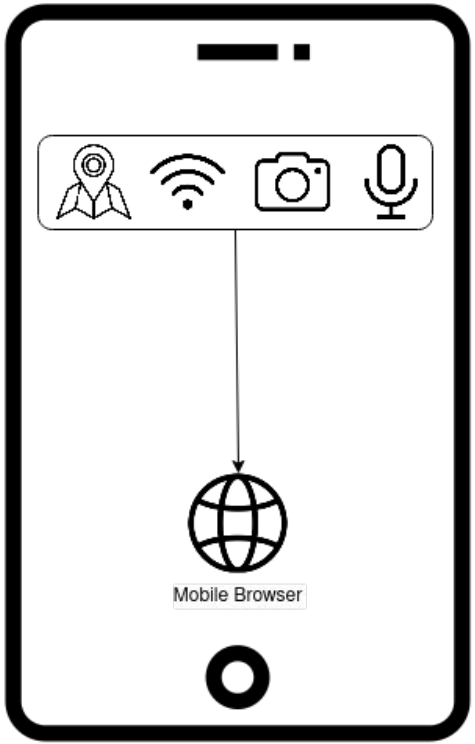

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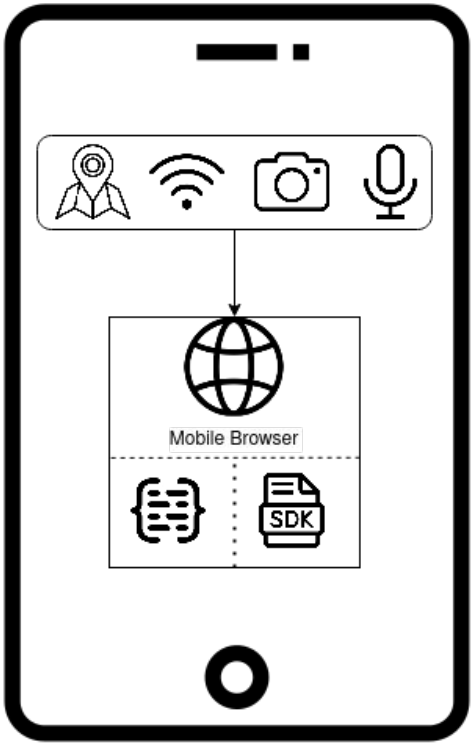

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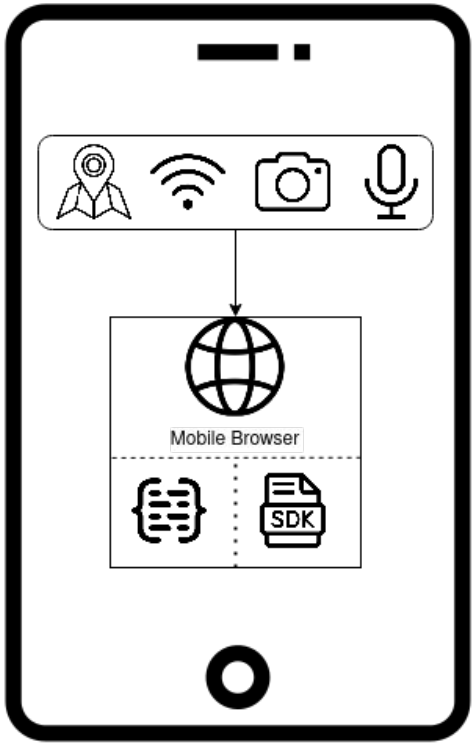

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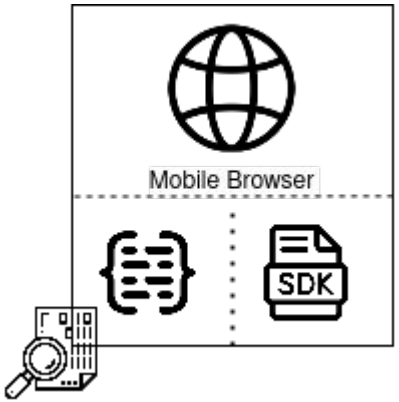

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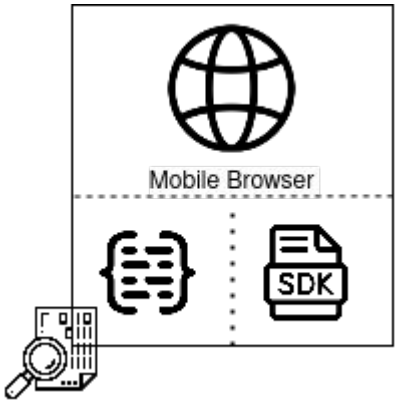

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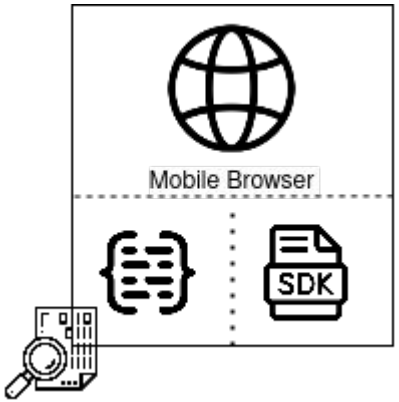
- 3rd party code analysis



Protections - Browsing the Internet

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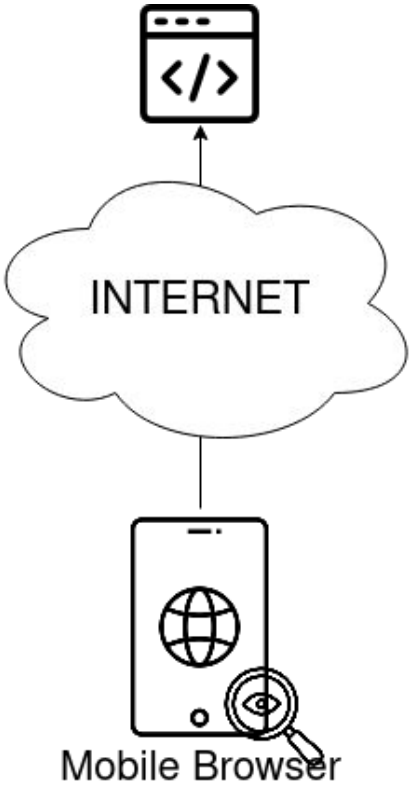

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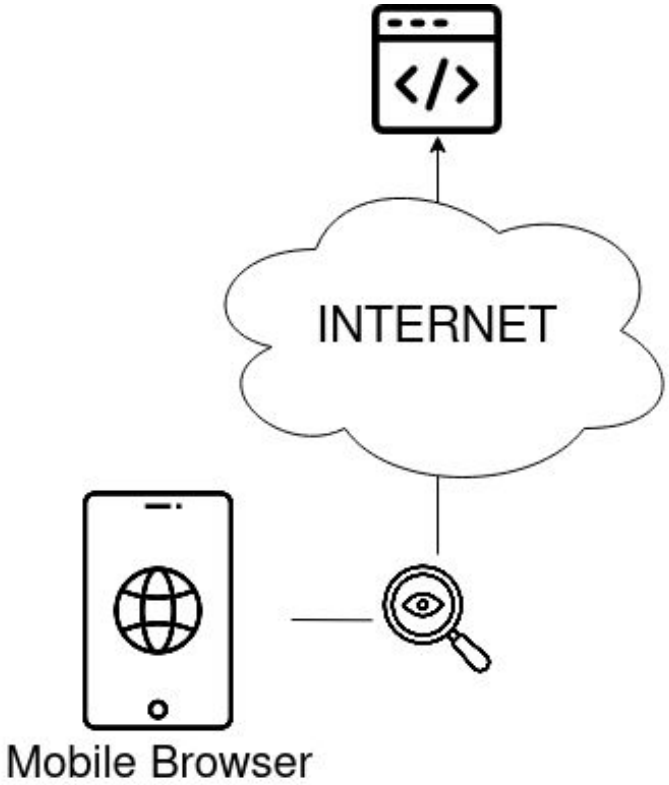
- Inspect network traffic



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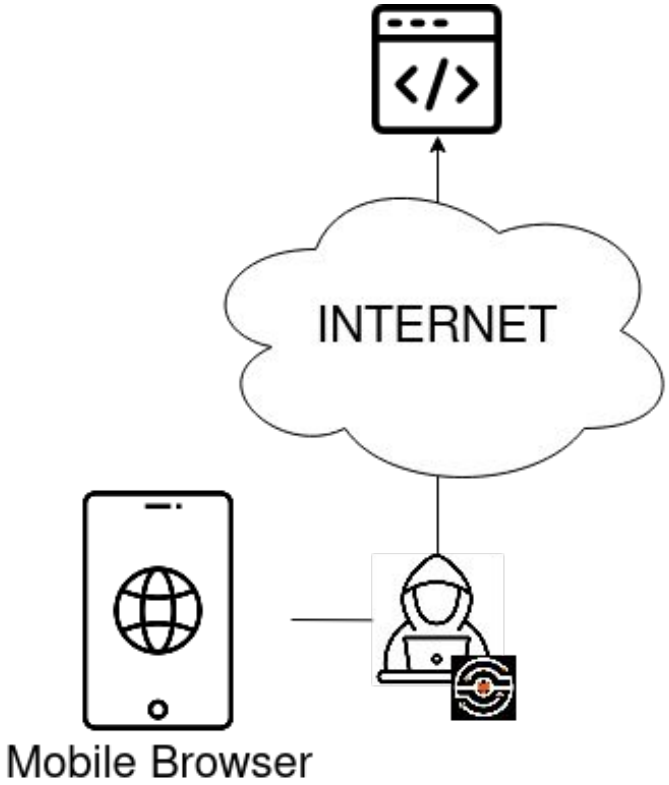

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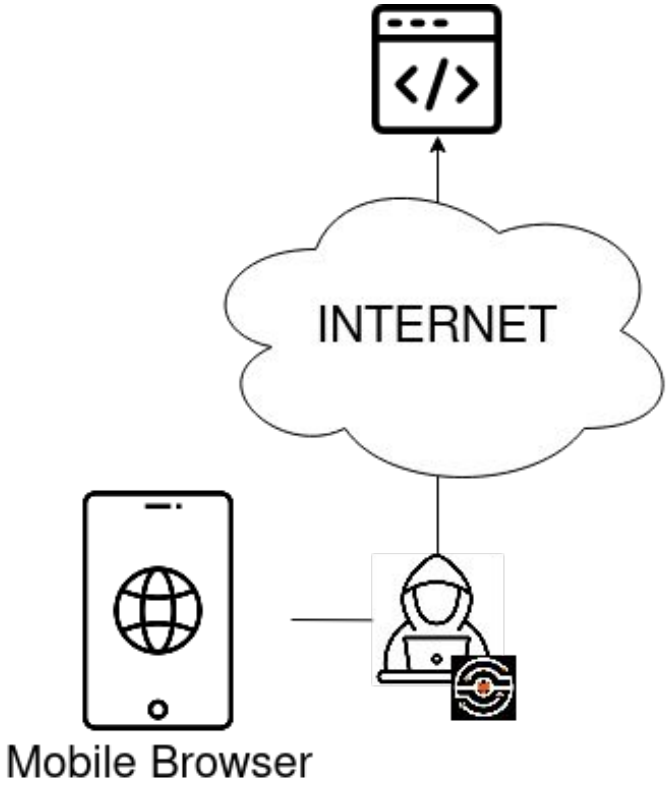

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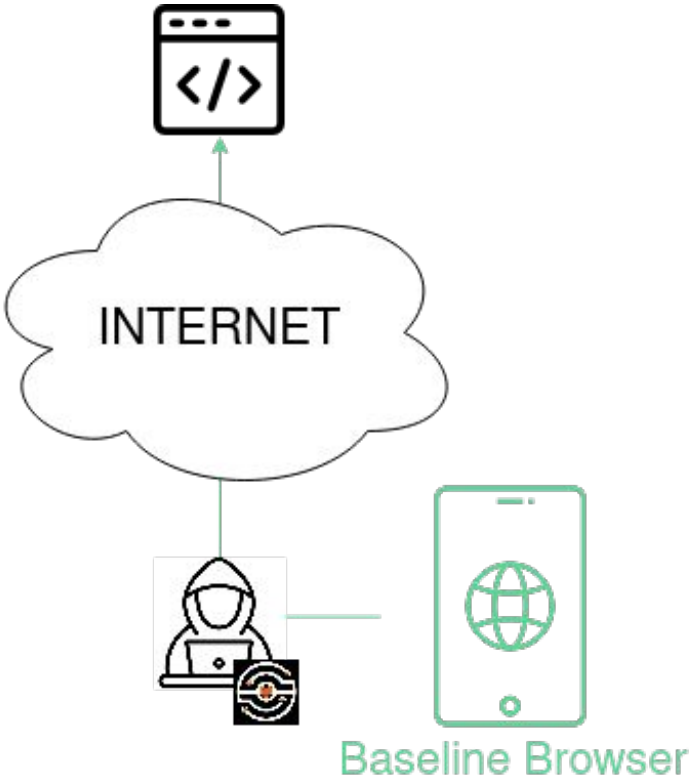

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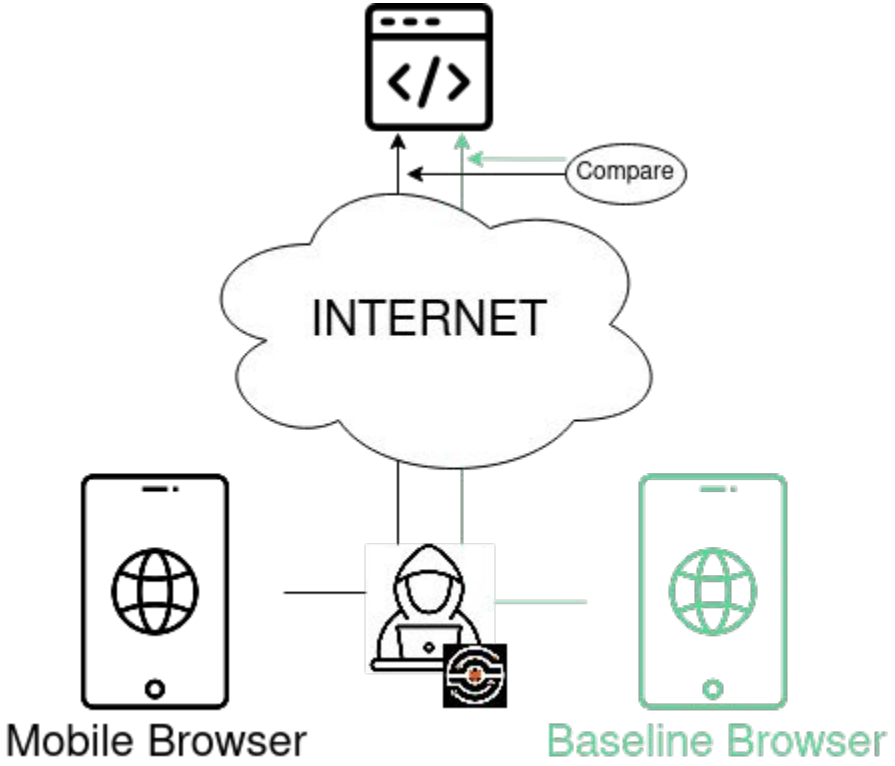
Baseline browser

- Compare traffic



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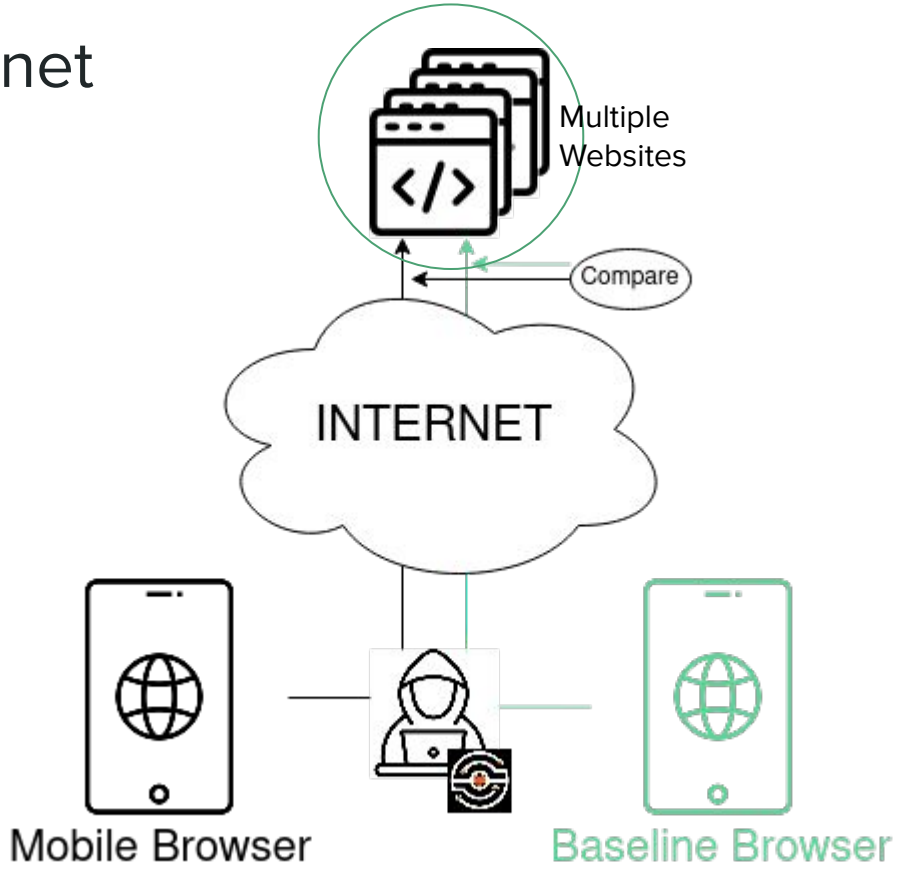

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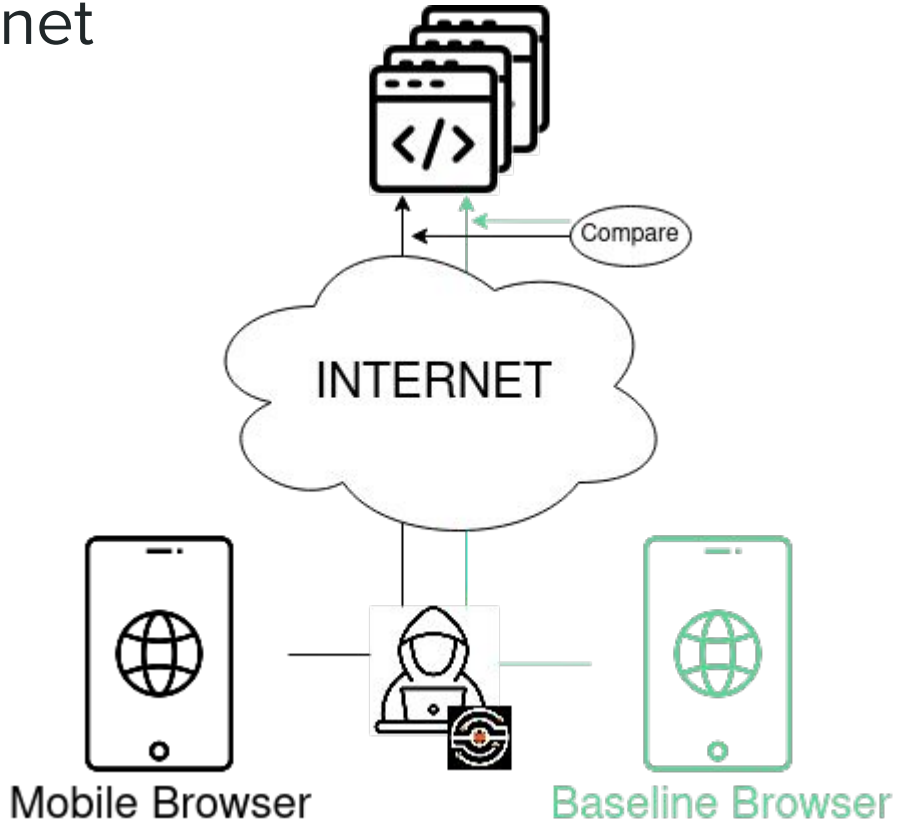
Do browsers render websites accurately?



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Do browsers render websites accurately?

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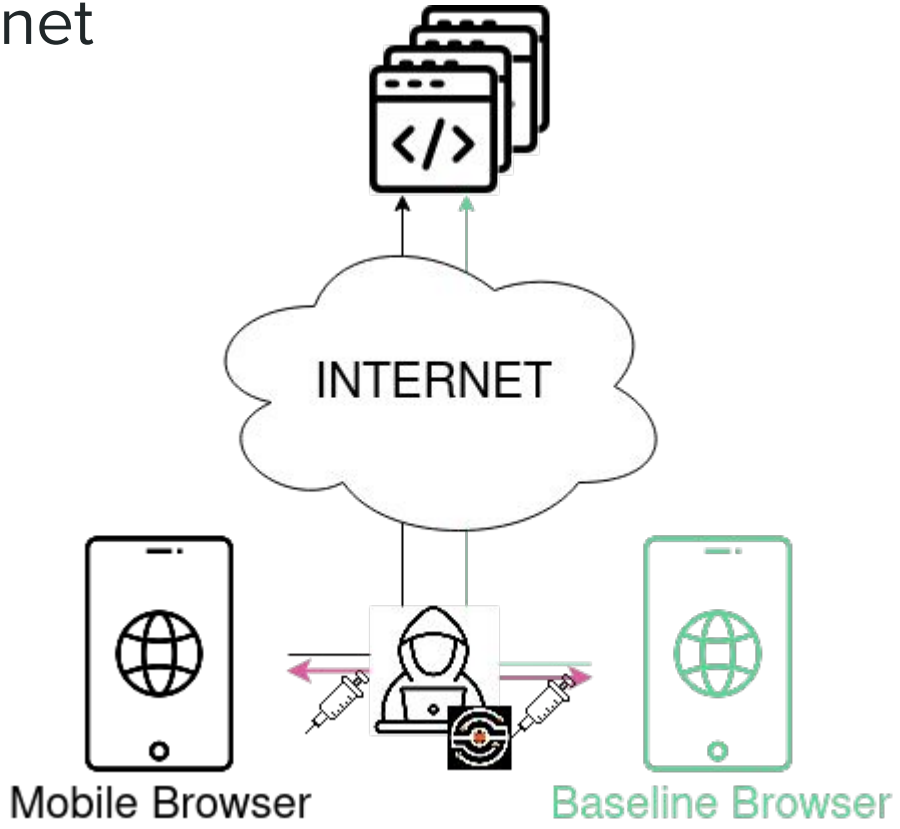
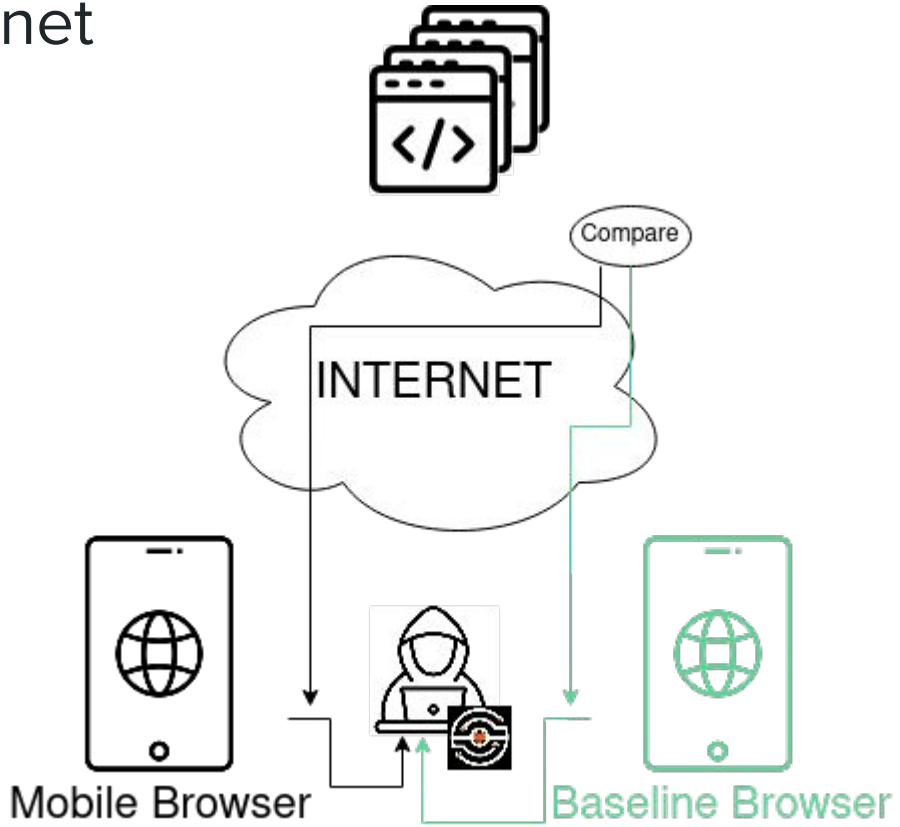


Protections - Browsing the Internet

Do browsers share user data with unrelated parties?

Do browsers render websites accurately?

- Inject with **mitmproxy**
- Obtain rendered content



Mobile Browsers - Collection & Identification

Google Play and 4 popular Chinese stores

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Well known browsers, app category, search for “browser”, etc.

Filtering False Positives

“Browser” ambiguous

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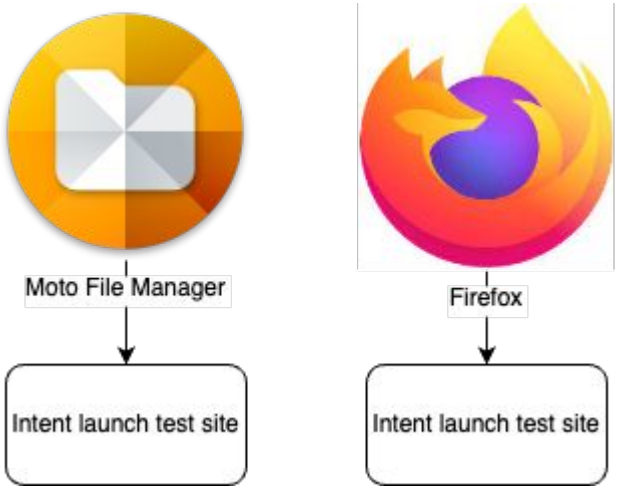
Try launching a website



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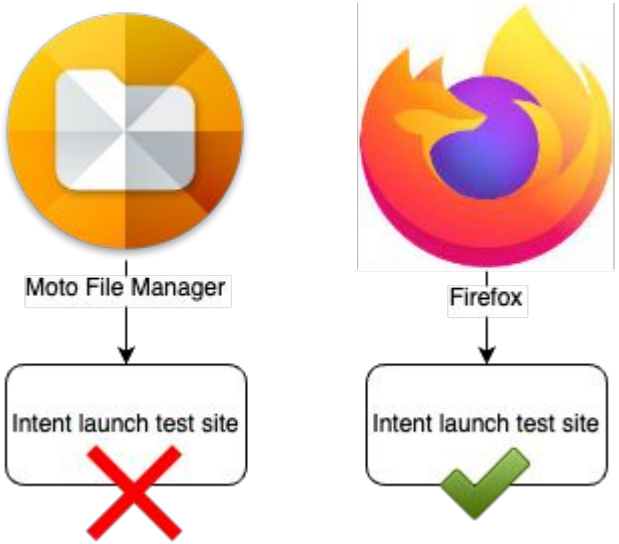

Filtering False Positives

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Try launching a website

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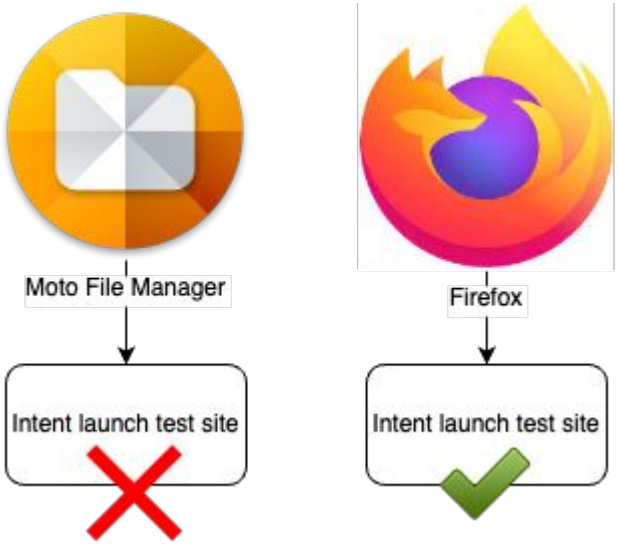
Total of **424** browsers



Putting It All Together

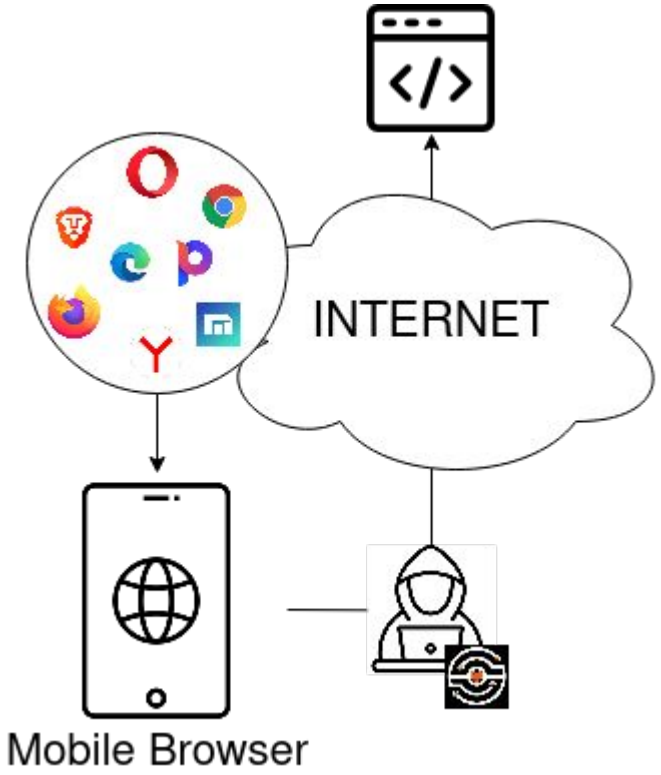
Multiple browsers

Multiple websites

Mitmproxy

Automate installation and tests

Baseline for ground truth



Results - Overview

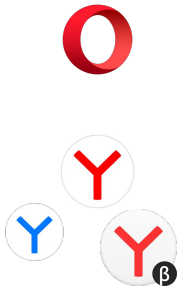
Browsing history collection

Identifier collection

Other harms/protections measured

Combined multidimensional analysis

Harms - Browsing History Collection



~3% (13 of 424) browsers send browsing history along with identifier(s)

~9% (37 of 424) share browsing history

- Was unrelated to any user-facing browser features

~14% (60 of 424) share browsing history

- Related to known browser feature (sitecheck, suggestion, search, etc.)
- Still poses a potential privacy risk

Harms - Observed Identifier Collection

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3 browsers **bridge IDs** (collect resettable and non-resettable IDs)

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- Collecting IMEI & Ad ID

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2% Play, 6% Chinese browsers collect non-resettable identifiers

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3 browsers **bridge IDs** (collect resettable and non-resettable IDs)

2% Play, 6% Chinese browsers collect non-resettable identifiers

32% browsers collect at least one identifier

Results - Other Harms and Protections

Harm Privacy

- 10% fail to validate TLS certificates

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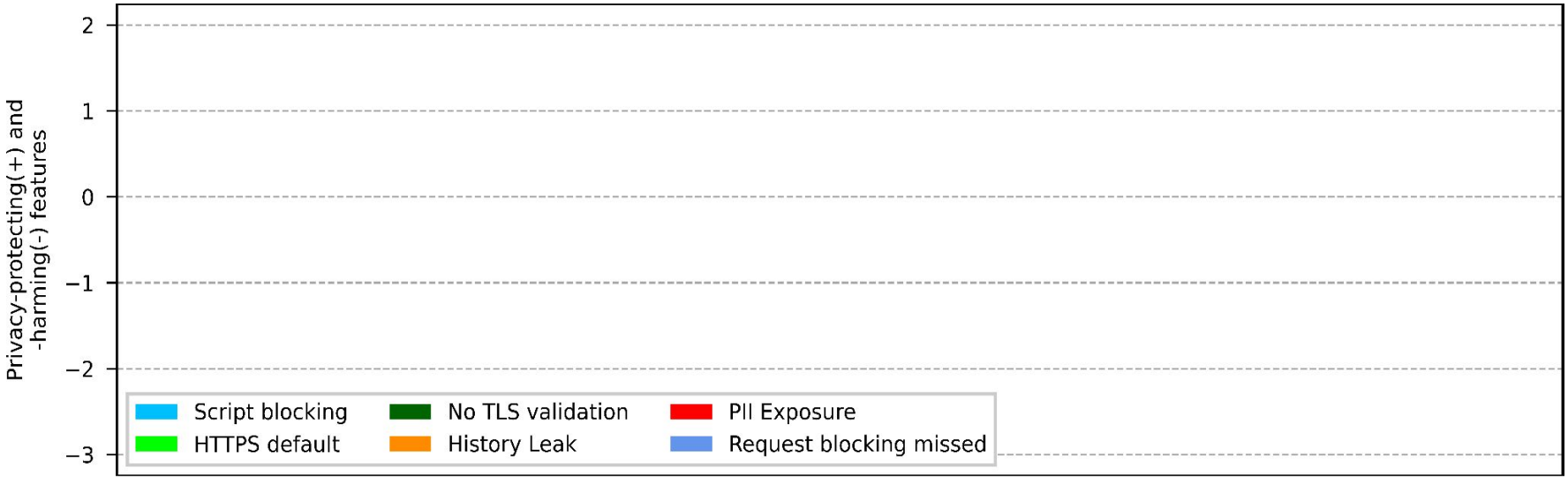
Harm Privacy

- 10% fail to validate TLS certificates

Protect Privacy

- 65% block trackers and 51% block scripts (from content modification analysis)
- 2% promote connection security, default to HTTP**S**

Results - Multidimensional Analysis



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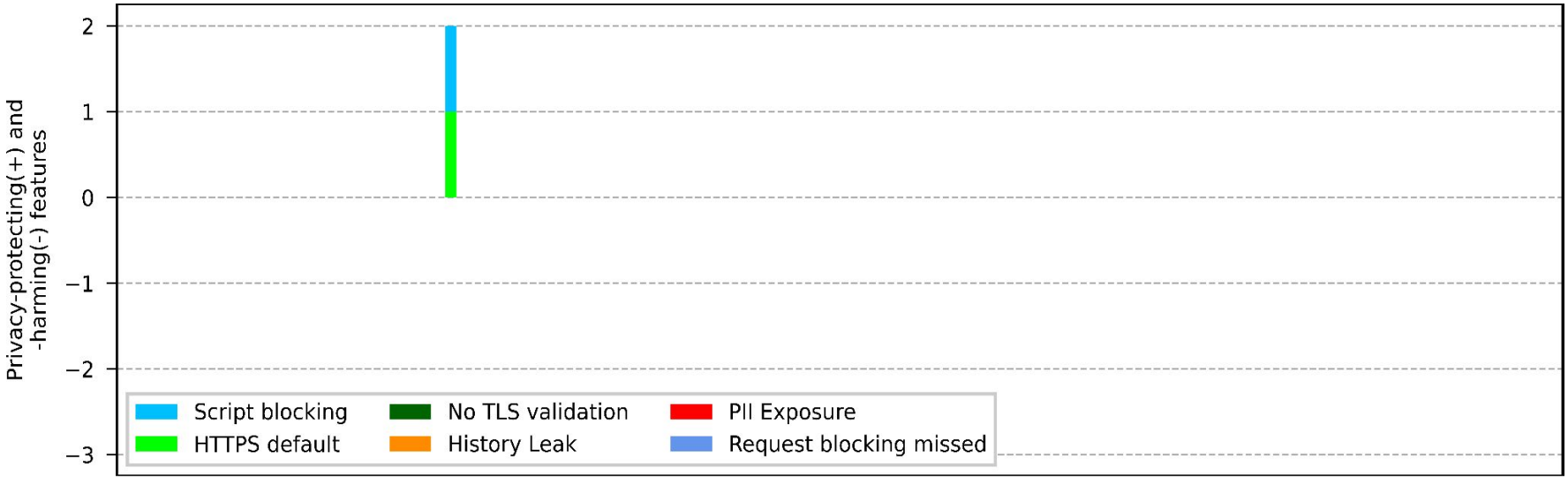

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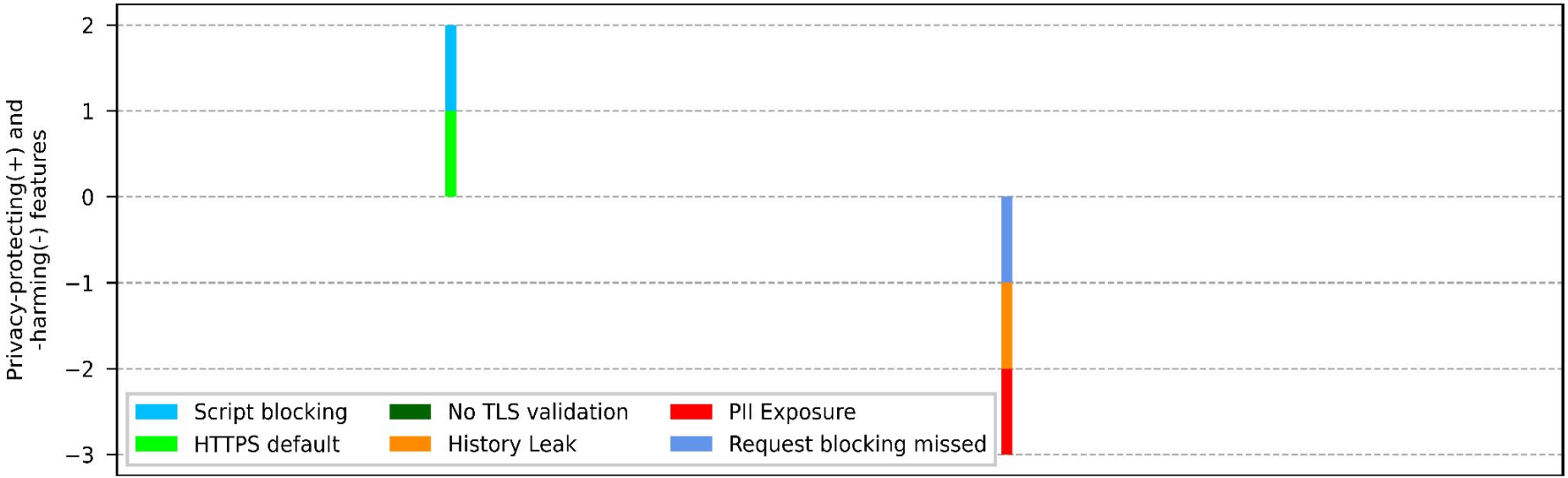

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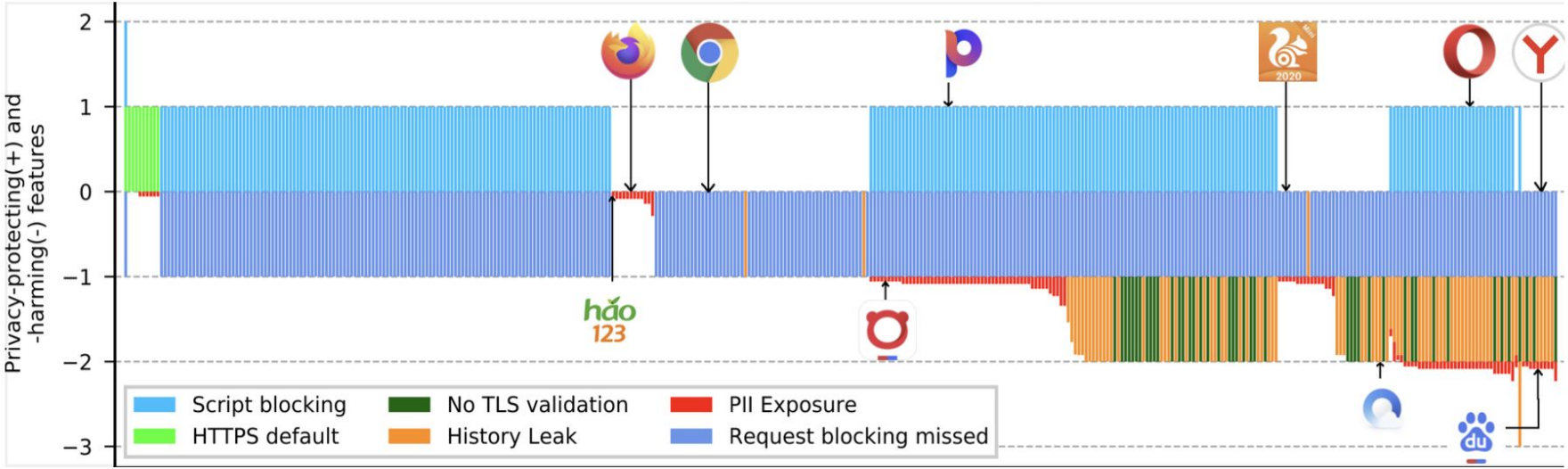

Mobile Browsers - Wrap Up

Evaluated privacy and security for a large set of mobile browsers

Findings:

- Most browsers (including popular) show mixed behavior
- History leaks are prevalent (~14%)
- *PII* collection is prevalent (~23%)

Apps, data, and analysis code are publicly available

Google disclosure

for the DDPRP program, but the information you provided was passed to our Trust and Safety team, leading to actions being taken against some of the apps.

Not Your Average App: A Large-scale Privacy Analysis of Android Browsers

https://neu-sns.github.io/mobile-browsers/

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Questions?