A Global Survey of Android Dual-Use Applications used in Intimate Partner Surveillance

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Intimate partner violence (IPV) affects people globally

“Intimate partner violence (IPV) is abuse or aggression that occurs in a romantic relationship” *

1 in 3
Women experience IPV

Major cause of death for women

IPV increased during COVID-19

Community problem affecting everyone

* https://www.cdc.gov/violenceprevention/intimatepartnerviolence/fastfact.html
Technology is increasingly being used in IPV

* Not an exhaustive list of how abusers use technology for IPS/IPH
IPS is a few clicks away

Prior work only focused on English/US dual-use apps [1-2]

...but we don’t know

How many and what types of dual-use apps are available in other languages?
Our Work: First **global** measurement study on dual-use apps

We crawled Android App stores in **15 languages** in 2020

Queries that mention IPS explicitly are **suggested** and **not always blocked** for some languages

We labeled **854** dual-use apps and estimate about **4000** dual-use apps.

Dual-use apps are more likely to be localized to **two or more languages** compared to an average app.

Dual-use apps no longer advertise IPS, but they still have **all the capabilities** of conducting IPS.
Global analysis of dual-use apps

- Prepared seed queries for 15 languages with native speakers
- Collected query suggestions from
  - Crawled and downloaded App metadata
  - Collected 51,868 unique apps
- Manual labelling of dual-use apps
- Manually flagged 854
- ML classification to remove obviously benign apps
- Translated metadata to English
Results and Findings
Google Play often suggests explicit IPS queries

<table>
<thead>
<tr>
<th>Query</th>
<th>Translation</th>
</tr>
</thead>
<tbody>
<tr>
<td>cara melacak pacar</td>
<td>how to track boyfriend</td>
</tr>
<tr>
<td>aplikasi cara melacak pacar</td>
<td>how to track boyfriend app</td>
</tr>
<tr>
<td>cara melacak lokasi pacar</td>
<td>how to track boyfriend location</td>
</tr>
<tr>
<td>cara melacak nomor hp pacar</td>
<td>how to track boyfriend's cell phone number</td>
</tr>
<tr>
<td>cara melacak hp pacar</td>
<td>how to track boyfriend's cell phone</td>
</tr>
</tbody>
</table>

Explicit IPS queries are suggested in **9 languages** including English.

More than 30 explicit IPS queries suggested in Malay (97), Portuguese (34), and Spanish (56).
Google Play often suggests explicit IPS queries

**Explicit IPS queries are suggested in 9 languages including English**

**More than 30 explicit IPS queries suggested in Malay, Portuguese, and Spanish**

**New 97 IPS queries found in Malay!**

- catch cheating app
- catch him cheating app free
- catch cheating boyfriend app
- app to catch cheating spouse
- app to catch cheating wife
- catch my boyfriend cheating app

<table>
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<tbody>
<tr>
<td>rastrear esposo</td>
<td>track husband</td>
</tr>
<tr>
<td>rastrear a mi esposo</td>
<td>track my husband</td>
</tr>
<tr>
<td>rastrear esposo</td>
<td>track husband</td>
</tr>
<tr>
<td>rastrear whatsapp do esposo</td>
<td>track husband's whatsapp</td>
</tr>
<tr>
<td>rastrear celular do esposo</td>
<td>track husband's cell phone</td>
</tr>
</tbody>
</table>

- cara melacak pacar    | how to track boyfriend |
- aplikasi cara melacak pacar | how to track boyfriend app |
- cara melacak lokasi pacar | how to track boyfriend location |
- cara melacak nomor hp pacar | how to track boyfriend's cell phone |
- cara melacak hp pacar | how to track boyfriend's cell phone |
Explicit IPS queries are not blocked in non-English languages

No IPS-query-blocking for 9 languages

Less than 10 blocked IPS queries for all languages except English (22)
Explicit IPS queries must be blocked and never suggested

<table>
<thead>
<tr>
<th></th>
<th>Blocked some IPS queries</th>
<th>Did NOT block any IPS query</th>
</tr>
</thead>
<tbody>
<tr>
<td>Suggested some IPS</td>
<td>Arabic, English, French, Portuguese, Russian,</td>
<td>German, Malay, Turkish</td>
</tr>
<tr>
<td>queries</td>
<td>Spanish</td>
<td></td>
</tr>
<tr>
<td>Did NOT suggest any</td>
<td><img src="image" alt="BEST CASE SCENARIO" /></td>
<td>Bengali, Chinese, Hindi, Japanese, Thai,</td>
</tr>
<tr>
<td>IPS query</td>
<td></td>
<td>Vietnamese</td>
</tr>
</tbody>
</table>

Stores should always block IPS queries and not suggest them to users.
No app explicitly promote IPS any more

but powerful IPS capabilities are available …
Distribution of IPS capabilities vary across languages

- **Locate**
  - Arabic: 46%
  - Bengali: 77%

- **Record**
  - German: 2%
  - Hindi: 37%

- **Share**
  - Spanish: 39%
  - Malay: 65%

- **Access**
  - Hindi: 5%
  - Vietnamese: 20%

- **Control**
  - English: 13%
  - Japanese: 28%
Dual-use apps are found in multiple queried languages

77% of dual-use apps found using at least 2 queried languages

27% of dual-use apps are not found using English queries
Dual-use apps are localized to multiple languages

- 47% of dual-use apps are available in at least 2 languages
- 17% of dual-use apps are not available in English
What about other Android app stores?
Crawling popular Chinese app stores

- 4 Popular app stores
- 2,484 Unique apps
- 110 Dual-use apps
- 93 Not in Play Store
- 13 in multiple stores
Comparison of dual-use apps in Chinese stores vs Play store

Better chance of finding dual-use apps in Play Store

Capabilities are distributed differently

<table>
<thead>
<tr>
<th>Capabilities</th>
<th>Play store</th>
<th>Chinese stores</th>
</tr>
</thead>
<tbody>
<tr>
<td>Locate</td>
<td>62%</td>
<td>65%</td>
</tr>
<tr>
<td>Control</td>
<td>21%</td>
<td>25.5%</td>
</tr>
<tr>
<td>Access</td>
<td>16%</td>
<td>27%</td>
</tr>
<tr>
<td>Share</td>
<td>40%</td>
<td>20%</td>
</tr>
<tr>
<td>Record</td>
<td>8%</td>
<td>20%</td>
</tr>
</tbody>
</table>
What changed since 2018?

- 83% of dual-use apps found in 2018 got deleted (Last checked: March 2022)
- Only 3 apps mentioned IPS explicitly in 2020
- 2,025 estimated dual-use apps found in 2022
A Global Survey of Android Dual-Use Applications

 OUR WORK

- Crawled Play store in 15 languages
- IPS queries are suggested and not always blocked
- Not all dual-use apps can be found using English queries
- Dual-use apps are available in multiple languages
- Abusers can still find powerful capabilities for IPS

 FUTURE WORK

- How to detect whether dual-use apps are abused?
- Are developers promoting IPS outside official stores?

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