Apps, Code, Culture, and Privacy Reform: Examining Influences on Android Permissions

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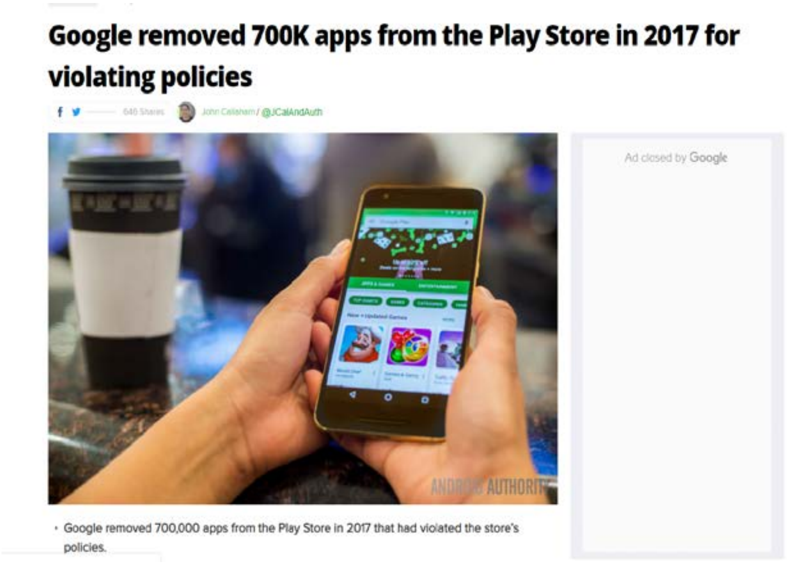
Motivation

- What are the driving factors that influence Android permissions over time?
- How has the Android permission usages changed from recent privacy reforms?
- Are there any relationships between permissions requested by applications in their respective category?
- Do privacy laws and regulations influence permission usage among Android apps?



Google removed 700K apps from the Play Store in 2017 for violating policies

646 Shares John Callaham / @JCalAndAuth

Ad closed by Google

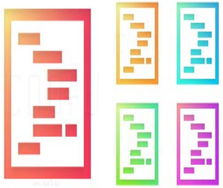
- Google removed 700,000 apps from the Play Store in 2017 that had violated the store's policies.

What Factors May Influence the Mobile Permission Environment?

Apps

Application Characteristics:
Google Rank, Category, Popularity

Code



Android Permissions:
“Normal” or “Dangerous”

Culture

Privacy Attitudes:
Location, Privacy Rights, etc.

Privacy Reform

Privacy Laws
Consumer Protections, Data Collection Practices, ect.

Why do we care?

- Over-Privileged Applications
- Advertisement Libraries

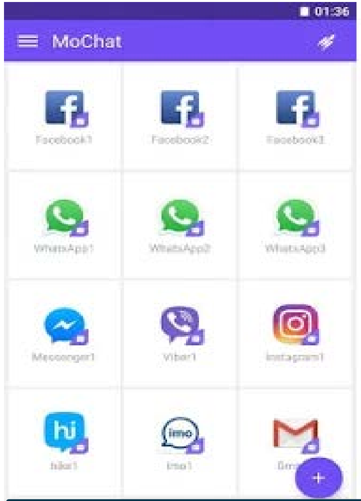
Case Study: MoChat

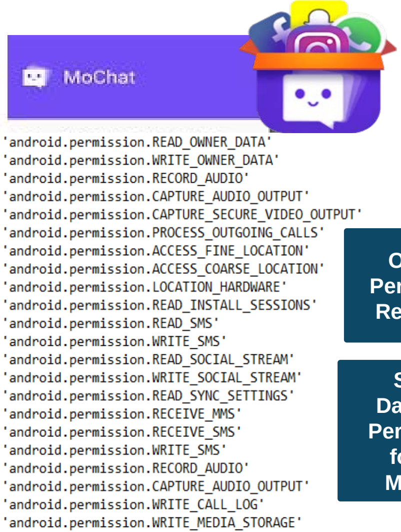
From Previous MoChat Privacy Policy:

*“We do not collect user’s personal information. User’s personal information refers to **user’s location,** age, address, phone, information stored in the device, and information used to identify the user or someone else when the user uses application, service or website.”*

But it does collect among other things:

Session Data: *“connection request, server communication and data sharing and contains network test, quality of service, date, time and **location.** Please note that session and available data exclude any personal information.”*





```
'android.permission.READ_OWNER_DATA'
'android.permission.WRITE_OWNER_DATA'
'android.permission.RECORD_AUDIO'
'android.permission.CAPTURE_AUDIO_OUTPUT'
'android.permission.CAPTURE_SECURE_VIDEO_OUTPUT'
'android.permission.PROCESS_OUTGOING_CALLS'
'android.permission.ACCESS_FINE_LOCATION'
'android.permission.ACCESS_COARSE_LOCATION'
'android.permission.LOCATION_HARDWARE'
'android.permission.READ_INSTALL_SESSIONS'
'android.permission.READ_SMS'
'android.permission.WRITE_SMS'
'android.permission.READ_SOCIAL_STREAM'
'android.permission.WRITE_SOCIAL_STREAM'
'android.permission.READ_SYNC_SETTINGS'
'android.permission.RECEIVE_MMS'
'android.permission.RECEIVE_SMS'
'android.permission.WRITE_SMS'
'android.permission.RECORD_AUDIO'
'android.permission.CAPTURE_AUDIO_OUTPUT'
'android.permission.WRITE_CALL_LOG'
'android.permission.WRITE_MEDIA_STORAGE'
```

Over 400 Permissions Requested!

Several Dangerous Permissions found in Manifest!

And They Are Not Responsible In the Case of

1. **Hackers' attack**
2. Major impact caused by telecommunications operators;
3. Network or website closed due to government regulation;
4. **Virus attack**
5. Natural disasters, war and other events that can not be reasonably controlled, predicted or avoided even if they can be predicted

Methodology

Collecting and parsing app permission data

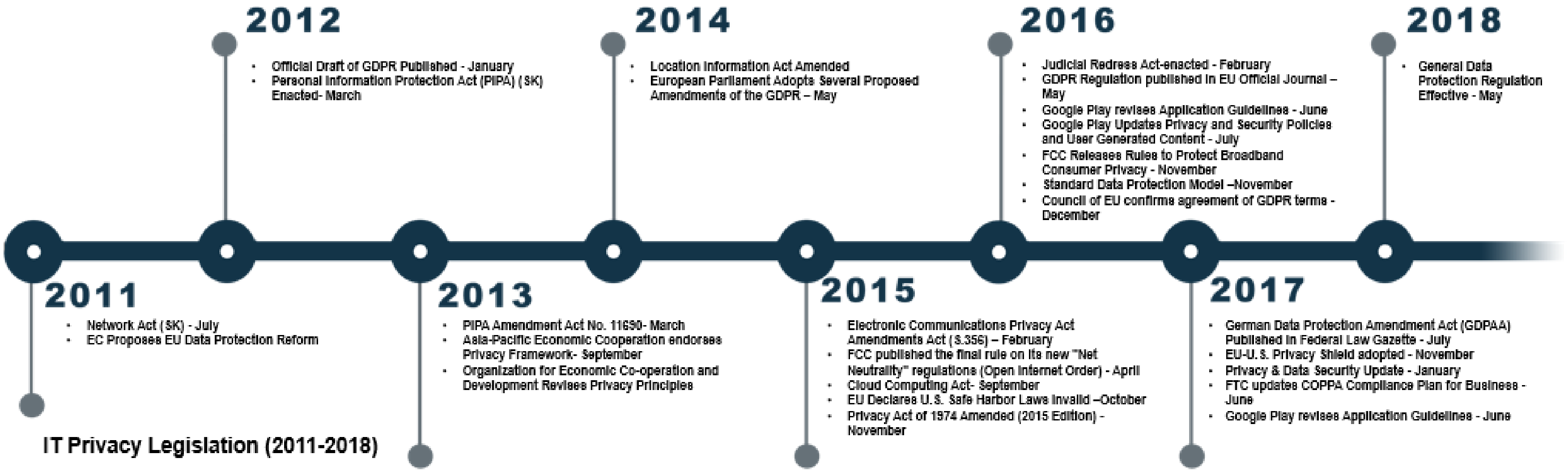
- 4623 Android Apps Pre-GDPR
- 4674 Android Apps Post-GDPR

Extracted permission data from APK files using Androguard

Analyzed relationships between app permissions requested from variables such as:

- Location
- Age
- Popularity
- Category
- Rank
- Size
- IT Privacy Law

Privacy Legislation Evolution



2011

- Network Act (SK) - July
- EC Proposes EU Data Protection Reform

2012

- Official Draft of GDPR Published - January
- Personal Information Protection Act (PIPA) (SK) Enacted- March

2013

- PIPA Amendment Act No. 11690- March
- Asia-Pacific Economic Cooperation endorses Privacy Framework- September
- Organization for Economic Co-operation and Development Revises Privacy Principles

2014

- Location Information Act Amended
- European Parliament Adopts Several Proposed Amendments of the GDPR – May

2015

- Electronic Communications Privacy Act Amendments Act (S.356) – February
- FCC published the final rule on its new "Net Neutrality" regulations (Open Internet Order) - April
- Cloud Computing Act- September
- EU Declares U.S. Safe Harbor Laws Invalid –October
- Privacy Act of 1974 Amended (2015 Edition) - November

2016

- Judicial Redress Act-enacted - February
- GDPR Regulation published in EU Official Journal – May
- Google Play revises Application Guidelines - June
- Google Play Updates Privacy and Security Policies and User Generated Content - July
- FCC Releases Rules to Protect Broadband Consumer Privacy - November
- Standard Data Protection Model –November
- Council of EU confirms agreement of GDPR terms - December

2017

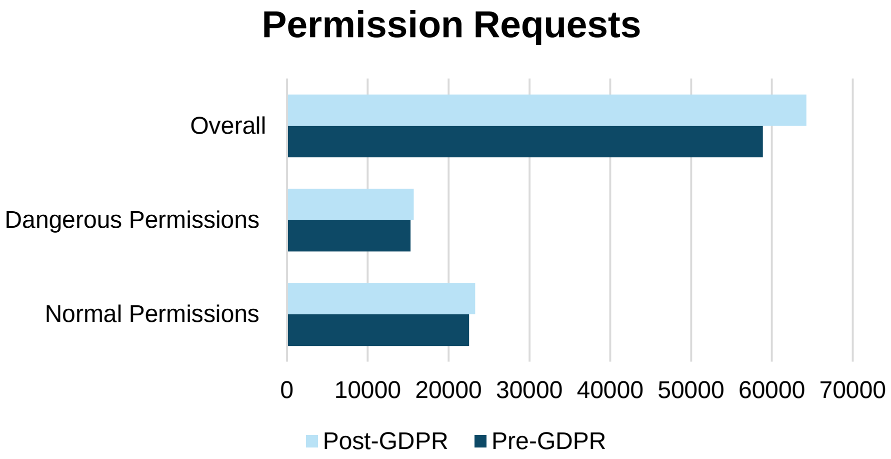
- German Data Protection Amendment Act (GDPAA) Published in Federal Law Gazette - July
- EU-U.S. Privacy Shield adopted - November
- Privacy & Data Security Update - January
- FTC updates COPPA Compliance Plan for Business - June
- Google Play revises Application Guidelines - June

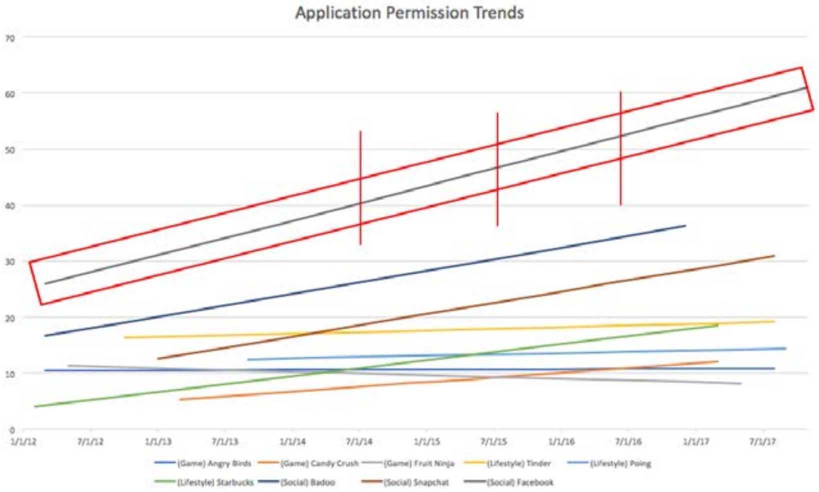
2018

- General Data Protection Regulation Effective - May

IT Privacy Legislation (2011-2018)

Android App Permissions Over Time



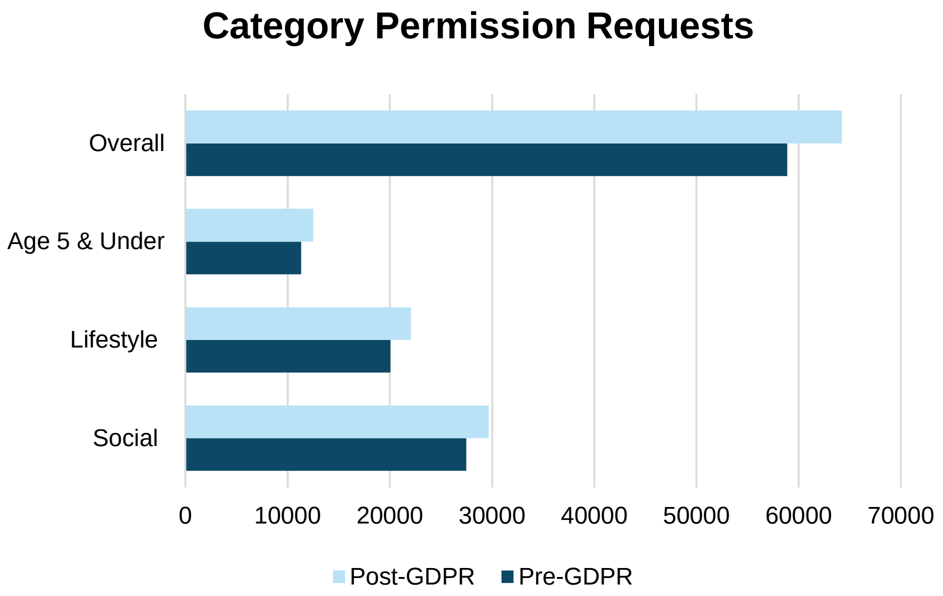


Facebook:

(2014) Facial Recognition (2015) Friend to Friend Payment
(2015) Caller ID Integration (2015/16) Live Stream

Android App Permissions Over Time

- App Permissions Grow (+9%)
- Game Applications Stable (+2 P/YR)
- Social and Lifestyle Applications Grow Quickly (+4.4 P/YR)
- Statistical Analysis: P-Value < .001

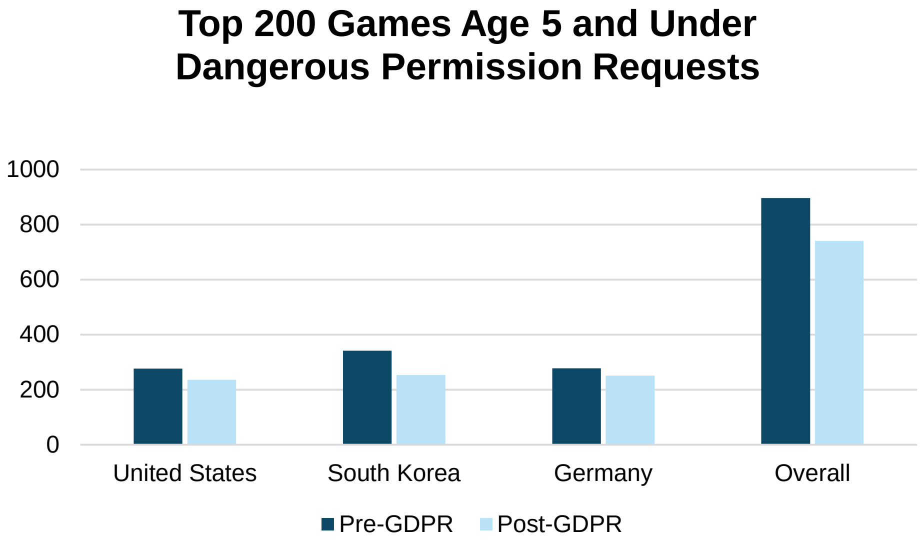


Dangerous App Permissions Over Time

Decreased dangerous permission requests among all three countries:

- United States: **-14%**
- South Korea: **-26%**
- Germany: **-10%**

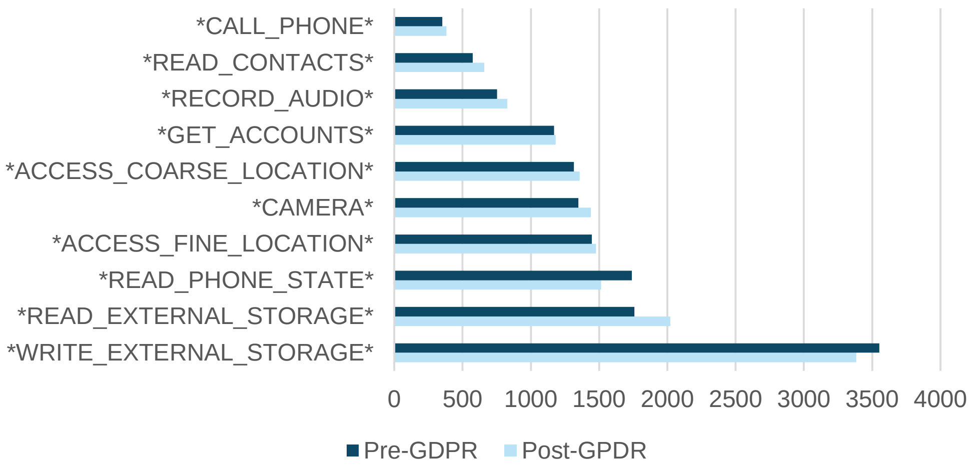
Overall decreased dangerous permission request frequency: **-17%**



Dangerous Permission Frequency

- Read and Write External mobile device storage remains most frequently requested.

- Location and audio access remain among top frequently occurring dangerous permission requests
  - 1358 total permissions requested to access precise location.
  - Over 800 total requests to access and record audio. **(+10% Post-GDPR)**



Top 10 Dangerous Permission Requests

Aggregate Trends in Mobile Permissions

- Collectively both “Normal” and “Dangerous” permission requests are increasing over time.
- Frequency rates of dangerous permission requests decrease in certain categories and countries.
- Readable permission requests to access external storage and location data are increasing.

READ_EXTERNAL_STORAGE: (**2021 requests**)

ACCESS_FINE_LOCATION: (**1476 requests**)

Conclusion

- Limited evidence of regulatory impact
- More analysis may change conclusions
- Additional data compilation in progress
- Users should always be wary when giving access to sensitive PII as this can always end up in the wrong hands.