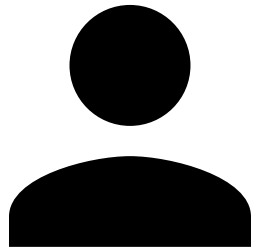


Assignment 1

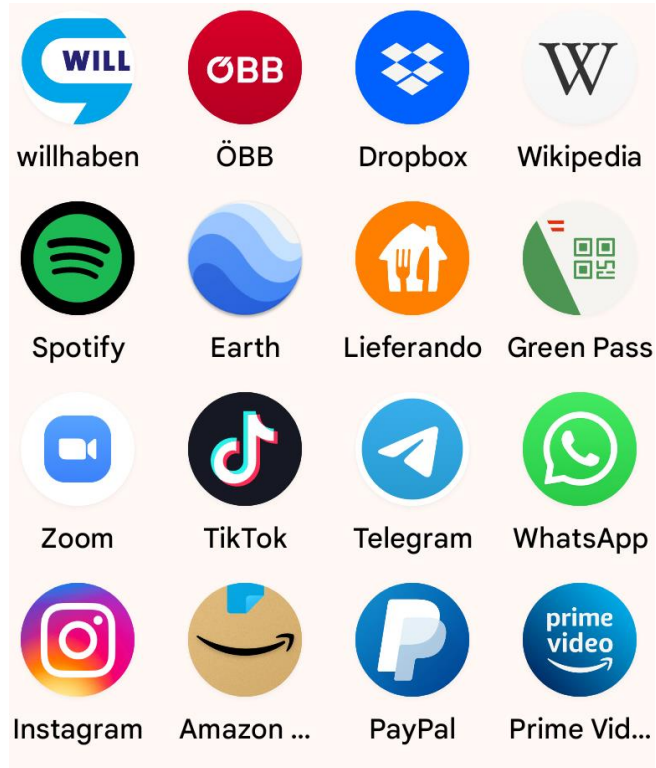
Mobile Security 2025

Florian Draschbacher
florian.draschbacher@tugraz.at

Some slides based on material by **Johannes Feichtner**



...wants
privacy

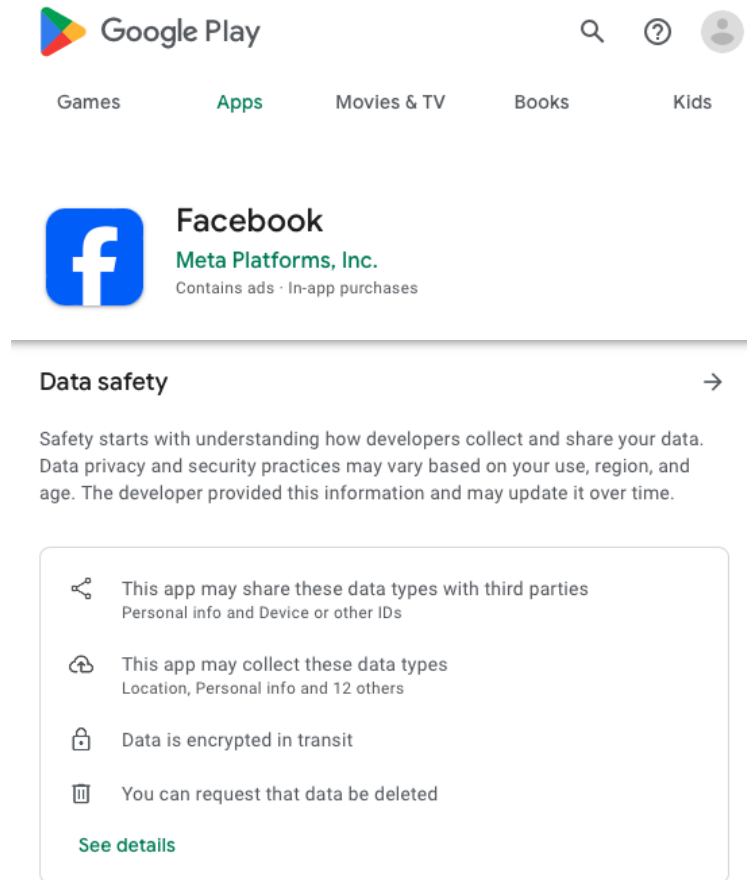


- *Am I talking to who I think I do?*
- *Does anyone tamper with my data?*
- *Who else gets access to my data?*
- *What information do they process, collect or share?*

Data Safety Section on Google Play

- Permissions do not provide information on scope of data access
 - Is data processed, collected or shared?
- In 2022, Google introduced a **Data Safety Section** to Google Play
- Developer needs to disclose
 - What data does the app process, collect or share?
 - For what purpose is data shared?
 - Is disclosure optional?
 - Are security best practices followed?

Data Safety Section on Google Play



Google Play

Games Apps Movies & TV Books Kids

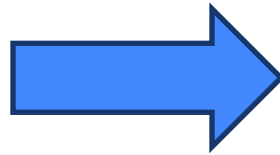
Facebook
Meta Platforms, Inc.
Contains ads · In-app purchases

Data safety →

Safety starts with understanding how developers collect and share your data. Data privacy and security practices may vary based on your use, region, and age. The developer provided this information and may update it over time.

- 🔗 This app may share these data types with third parties
Personal info and Device or other IDs
- 📁 This app may collect these data types
Location, Personal info and 12 others
- 🔒 Data is encrypted in transit
- 🗑️ You can request that data be deleted

[See details](#)



Data safety

Here's more information the developer has provided about the kinds of data this app may collect and share, and security practices the app may follow. Data practices may vary based on your app version, use, region, and age. [Learn more](#)



Data shared

Data that may be shared with other companies or organizations

- 👤 **Personal info** ✓
Name, Email address, User IDs, and Phone number
- 📱 **Device or other IDs** ✓
Device or other IDs




Data collected

Data this app may collect

- 📁 **Files and docs** ✓
Files and docs
- 📷 **Photos and videos** ✓
Photos and Videos

Are developers honest about their apps?




Lalaine: Measuring and Characterizing Non-Compliance of Apple Privacy Labels
Yue Xiao, Zhengyi Li, and Yue Qin, *Indiana University Bloomington*;
Xiaolong Bai, *Orion Security Lab, Alibaba Group*; Jiale Guan, Xiaojing Liao,
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<https://www.usenix.org/conference/usenixsecurity23/presentation/xiao-yue>



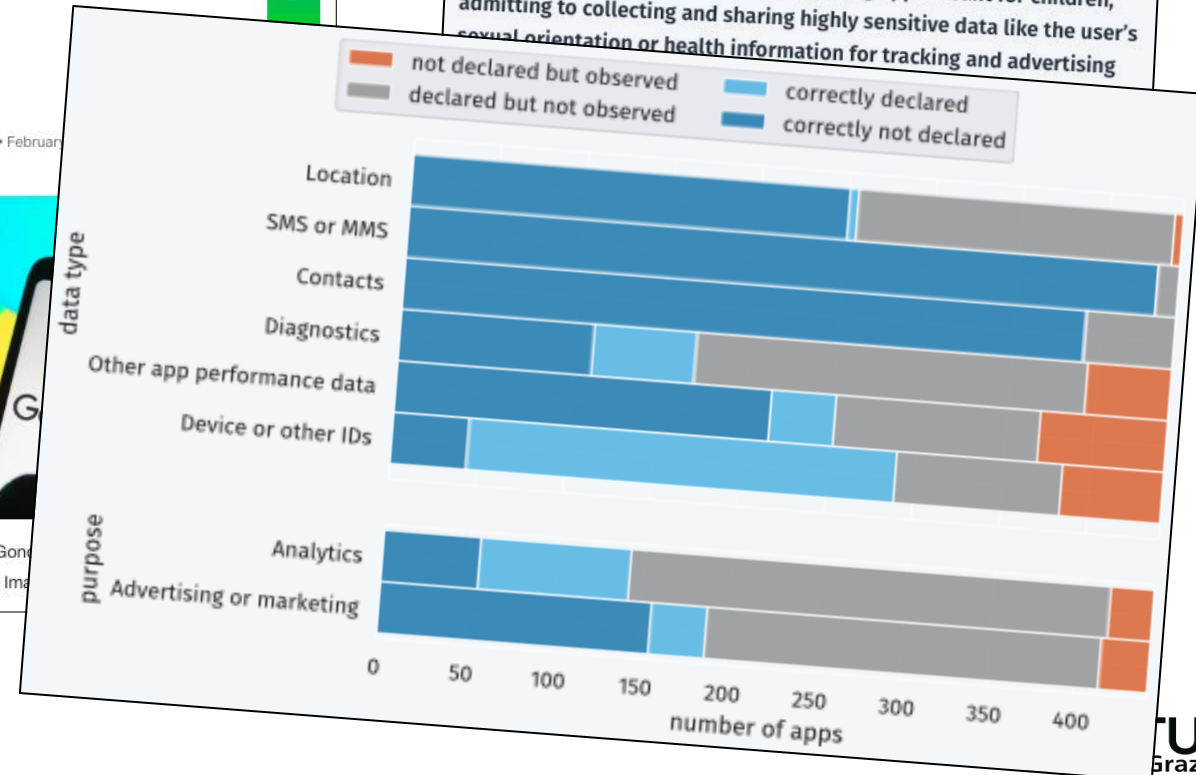
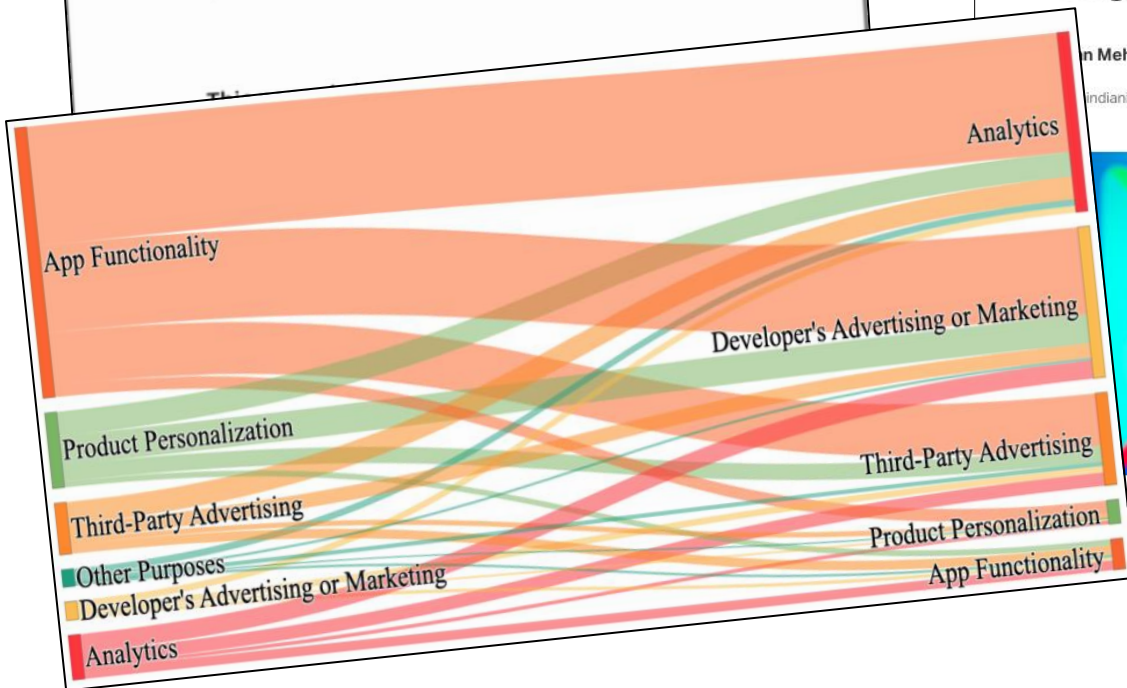
Apps

Popular Android apps' Play Store privacy labels don't match up to their claims, Mozilla says




Worrying confessions: A look at data safety labels on Android


The Google Play Store recently introduced a data safety section in order to give users accessible insights into apps' data collection practices. We analyzed the labels of 43,927 popular apps. Almost one third of the apps with a label claims not to collect any data. But we also saw often downloaded apps, including apps meant for children, admitting to collecting and sharing highly sensitive data like the user's **sexual orientation or health information for tracking and advertising**



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Apps

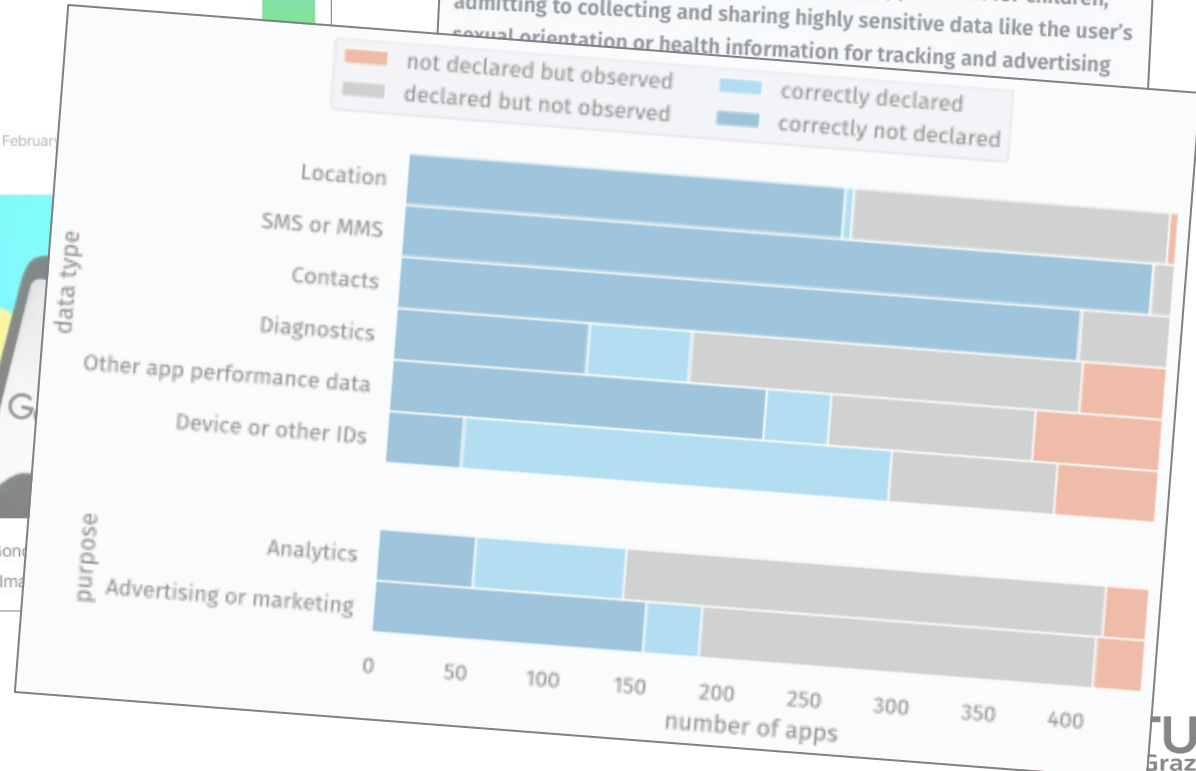
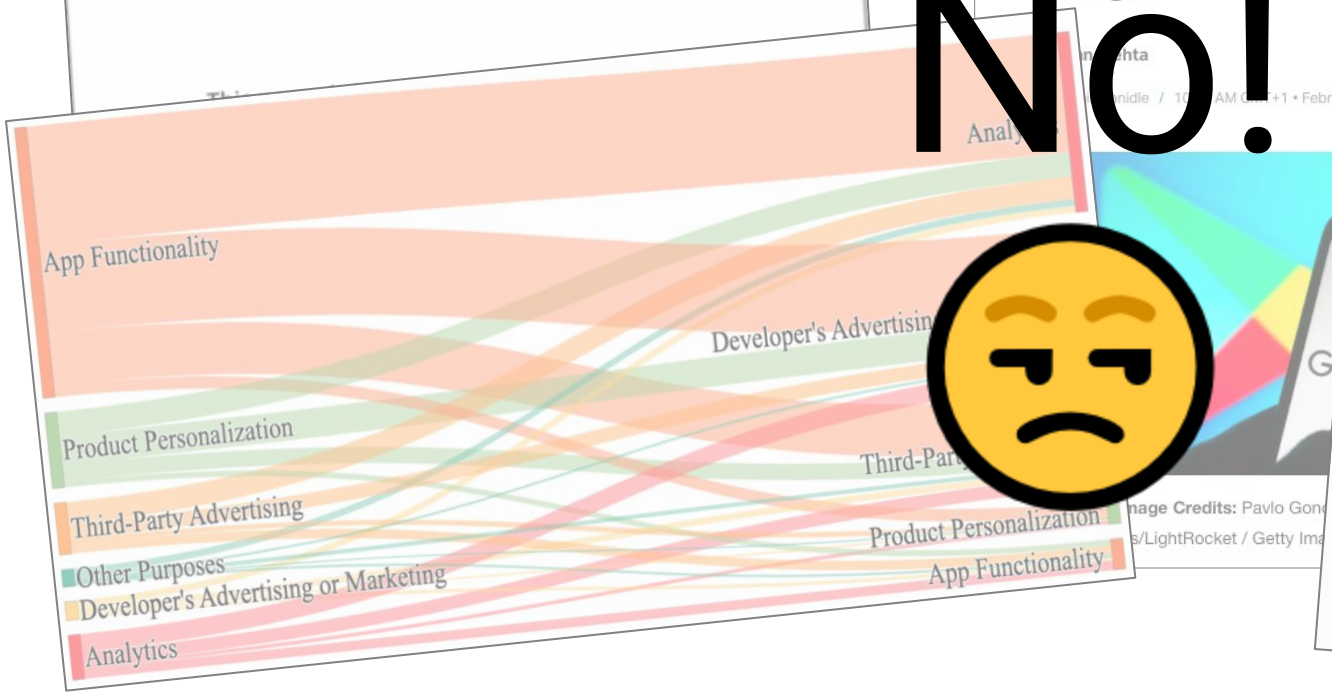
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No!



Your Task

Task 1

Analyse a set of **3 applications**

- Find out what data they transmit to their backend server
- Check if their Data Safety Section is accurate

Roadmap for each app:

1. Carry out MITM attack to intercept backend communication
2. Analyze transmitted data
3. Compare with Data Safety Section
4. Write report of your findings

Grading of Task 1: Your result report

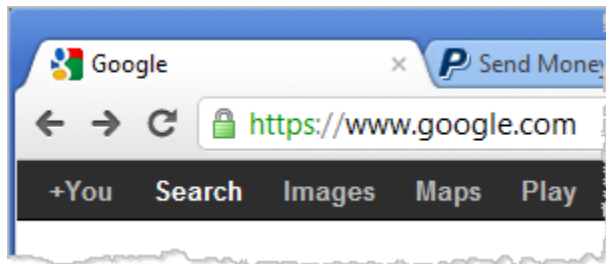
Recap: Man-in-the-middle



Active attacker

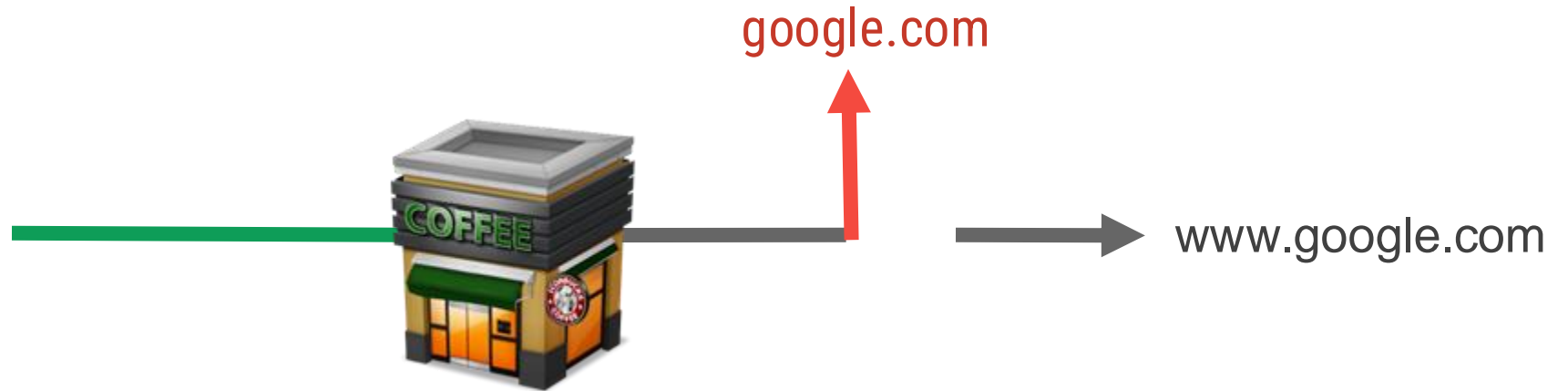
Secretly relay (and possibly modify) traffic between client and server

Picture: [Google](#) / [Apache 2.0](#)



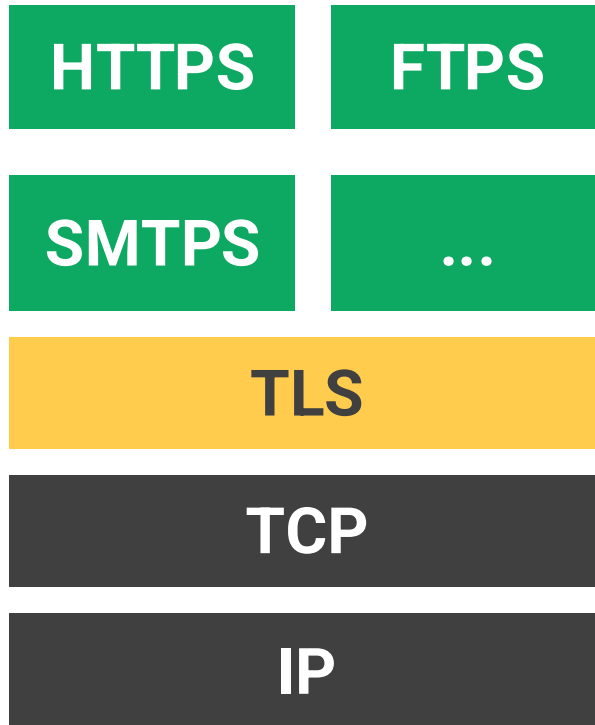
Client

Ideally does not notice anything (from an attacker's perspective)



Picture: [blaugrana-tez](#) / [CC BY-NC-ND](#)

Recap: Transport Layer Security



Problem: „Secure Identity“

Problem: Key Exchange

Recap: Practical Defenses against MITM

- Use Transport Layer Security
- Validate server certificate chain
 - From server certificate to device-installed CA
 - Baseline of TLS security
 - Some developers disable validation for supporting self-signed certificates
 - Very bad idea!
- Implement certificate pinning
 - Hard-code the expected hash of the server certificate
 - Prevents attacks that
 - Involve state actors, malicious or compromised CAs
 - Involve users who installed additional CA certs to their device

TLS on Android

- `SSLSocket` class for establishing secure TLS or SSL connection
- Validating certificate chain: `TrustManager`
 - Default: Trust any CA installed on device
 - Custom implementations may perform any validation logic (or none at all)
- Ensuring certificate hostname matches server hostname: `HostnameVerifier`
 - Has to be invoked by code above `SSLSocket`
 - Developer's responsibility!

HTTPS on Android

- Use Android's `HttpsURLConnection` class
 - By default: `SecureTrustManager` and `HostnameVerifier` (Details depend on Android version)
 - Possibility to use custom `TrustManager` and `HostnameVerifier`
- Use a third-party library such as `OkHttp` (built on top of `SSLSocket`)
 - Usually secure custom `TrustManager` and `HostnameVerifier`
 - Support self-signed certificates, certificate pinning, ...
- Implement a custom HTTP stack on top of `SSLSocket`
 - Secure system-default `TrustManager`
 - `HostnameVerifier` up to developer!

Situation Pre-Android 7

Q: “Does someone know how to accept a self-signed certificate on Android?

A code sample would be perfect.”

A: “Use the AcceptAllTrustManager”.

Q: “All I need to do is download some basic text-based and image files from a web server that has a self-signed SSL certificate...getting the SSL to work is a nightmare...”

A: “I found two great examples of how to accept self-signed SSL certificates, one each for `HttpsURLConnection` and `HttpClient`.”

[Source: Stackoverflow]

Applications

- Can overwrite certificate validation routines (system default: correct check)
- Self-signed certificates → used to require custom TrustManager
- Used to have to implement pinning on their own if wanted

Network Security Configuration (Android 7)

- XML-based system for configuring self-signed certificates and pinning
- These use cases no longer require custom validation code
- Default NSC: Don't trust user-installed CA certificates

However

- Even the NSC can be misconfigured
 - Trust user-installed CAs
- Some applications still use custom TrustManagers or HostnameVerifiers
 - Overrides the NSC system altogether

Task 1 – Detailed Steps (for each of the 3 apps)

1. Try to intercept app's traffic using proxy server
2. If any HTTP connections or insecure HTTPS
→ Document this fact, go to step 5
3. Decompile app to find out how pinning is implemented
 - HTTP library, NSC, custom TrustManager?
4. Modify app to trust user-installed CAs
 - E.g. Recompile, resign, reinstall the app
5. Analyse the intercepted server communication
 - Is the Google Play Data Safety section accurate?
6. Document all findings in a scientific report

More details on
assignment website

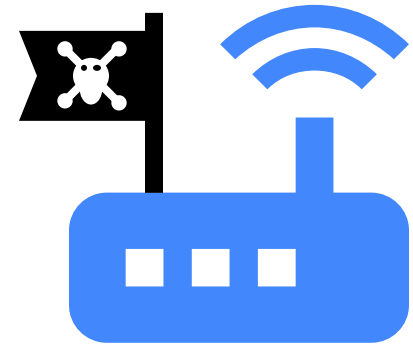
On the dark side...

MITM attack tools

- mitmproxy.org, Fiddler, Proxyman, ...

Decompiling and modifying Android apps

- JADX, Apktool
- Uber-APK-Signer
- A2P2 – Android Application Patching Pipeline
<https://extgit.isec.tugraz.at/fdraschbacher/a2p2>
- Frida, Android-Unpinner
- Whatever way you choose for bypassing TLS pinning, document how it works!
 - Your report must prove you understand what is happening behind the scenes!



Picture: [Google](#) / [Apache 2.0](#)

Submission

- Submit **until 28.03.2025:**
 - Scientific report in PDF format
 - Email to mobilesec@iaik.tugraz.at
- **Describe how** you analysed each of the applications
 - Text, app screenshots, excerpts from dumps etc.
 - Provide reasoning for your approach
- **Describe** your findings
 - Is the communication protected as declared in the Data Safety section?
 - Is any data transmitted in conflict with the Data Safety section?
 - Any other interesting findings?

Reminder: Task 2

- Select a topic for assignment 2 until **21.03.2025**
- Plenty of topics to chose from on website
 - Or suggest your own!
- Groups of up to 3 people
 - But also possible to work on your own
- Send an email to mobilesec@iaik.tugraz.at about group members and topic

Questions?