IAIK TU Graz

Assignment 1

Mobile Security 2022

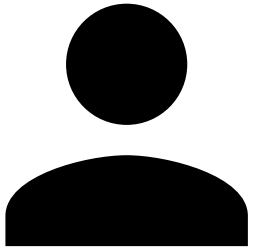
Florian Draschbacher
florian.draschbacher@iaik.tugraz.at

Slides based on those by **Johannes Feichtner**

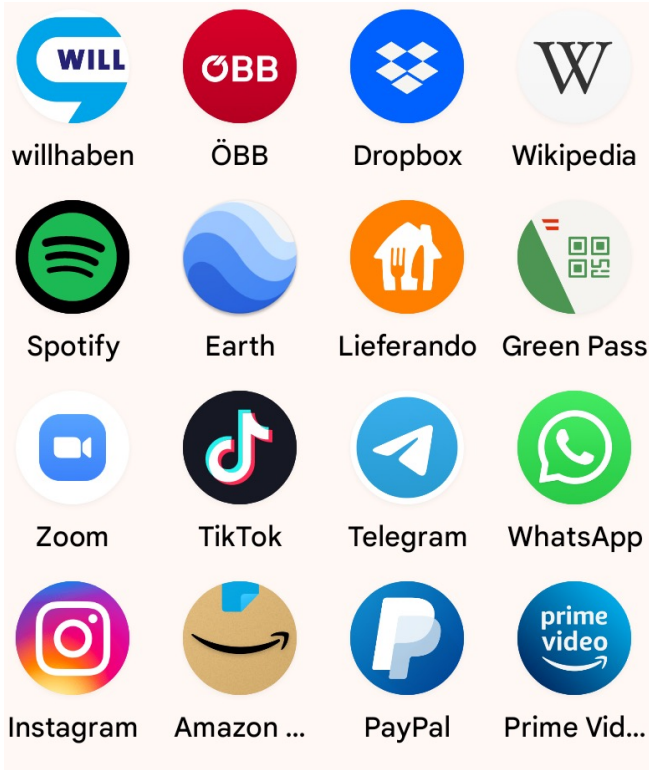
Addendum: We have a Discord channel

- If you have any questions regarding course material or assignments
  - And it might be of interest to other participants as well

1. Join the [IAIK Discord Server]
2. Open the `getting-started` channel
3. React with 

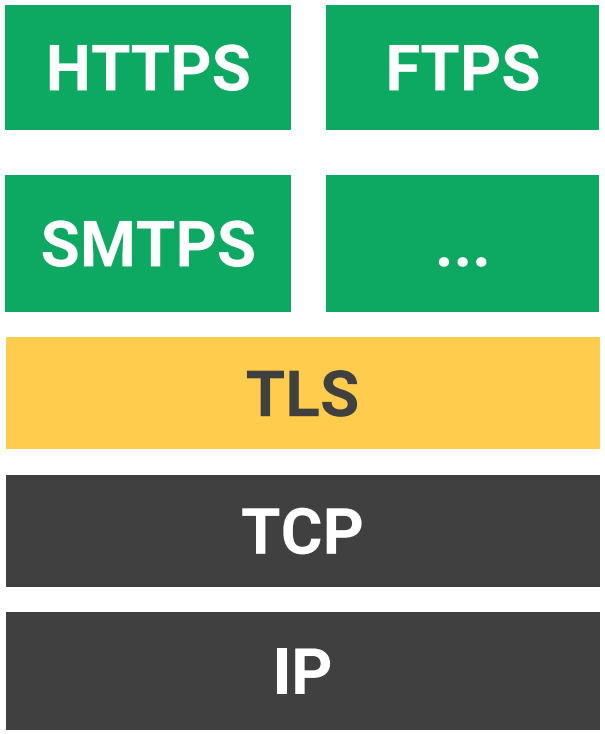


...wants privacy



- *Am I talking to who I think I do?*
- *Does anyone tamper with my data?*
- *Who else can see my conversation?*

Recap: Transport Layer Security



Problem: „Secure Identity“

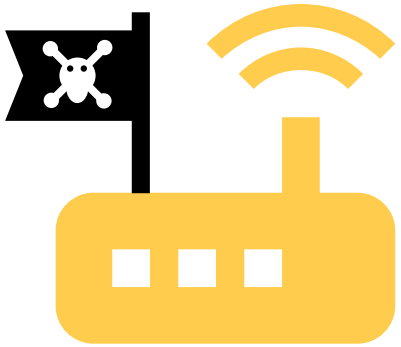
Authentication
Am I talking to who I think I do?

Data integrity
Does anyone tamper with my data?

Confidentiality
Who else can see my conversation?

Problem: Key Exchange

Recap: Man-in-the-middle



Active attacker

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

Picture: Google / Apache 2.0

Picture: blaugrana-tez / CC BY-NC-ND

Client

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

Practical Defenses

- 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: Secure `TrustManager` 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

Source: developer.android.com

Your Task

Task 1

Analyse a set of min. 3 applications

- Find out if they are susceptible to MITM
- If any sensitive data is transmitted
- Android recommended, iOS possible as well, but more complex

Roadmap

1. Select and install arbitrary apps on your phone
2. Get used to the topic of MITM / Pinning and learn an attack tool
3. Probe the chosen apps and summarize your results

Grading of Task 1: Your result report

Major impact on grade: Task 2 but positive finish only if you solve Task 1 and 2!

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

1. Try to intecept app's traffic using proxy server
2. If any HTTP connections or insecure HTTPS
   ➔ Document this fact, go to step 6
3. If you use iOS and your device is jailed:
   ➔ Find another app, go to 1
4. Decompile app to find out how pinning is implemented
   - HTTP library, NSC, custom TrustManager?
5. Android: Modify NSC to trust user-installed CAs
   - Recompile, resign, reinstall the app
6. Analyse the intercepted server communication
   - Sensitive data? Hard-coded secrets? Analytics?
7. Document all findings (screenshots + descriptions)

More details on assignment website

On the dark side…

MITM attack tools

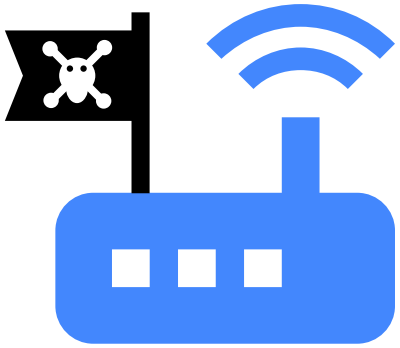
- mitmproxy.org

Decompiling and modifying Android apps

- JADX
- Apktool
- Uber-APK-Signer

Decompiling and analyzing iOS apps

- Ghidra
- Hopper



Picture: Google / Apache 2.0

Submission

- Submit **until 10.04.2022:**
  - No strict format but PDF recommended
  - List of analysed apps and versions
- **Describe how** you analysed each of the applications
  - Text, screenshots, excerpts from dumps etc.
  - Provide reasoning for your approach
- **Describe** your findings
  - Is any sensitive data leaked?
  - Is HTTP authorization used? Are the credentials hard-coded?
  - Does the app collect analytics?
  - Any other interesting findings?

Submission cont.

Submit until 10.04.2022:

- ZIP file with PDF and any supplementary materials (dumps, etc)
- Email to mobilesec@iaik.tugraz.at

- If your ZIP file is too large, upload it to
  - https://seafile.iaik.tugraz.at/u/d/3019662fd41f41bb8240/
  - Still send me an email, referencing uploaded file

Reminder: Task 2

- Select a topic for assignment 2 until **28.03.2022**
- **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?

Short tutorial today after the lecture