Why Does Your Data Leak? Uncovering the Data Leakage in Cloud from Mobile Apps

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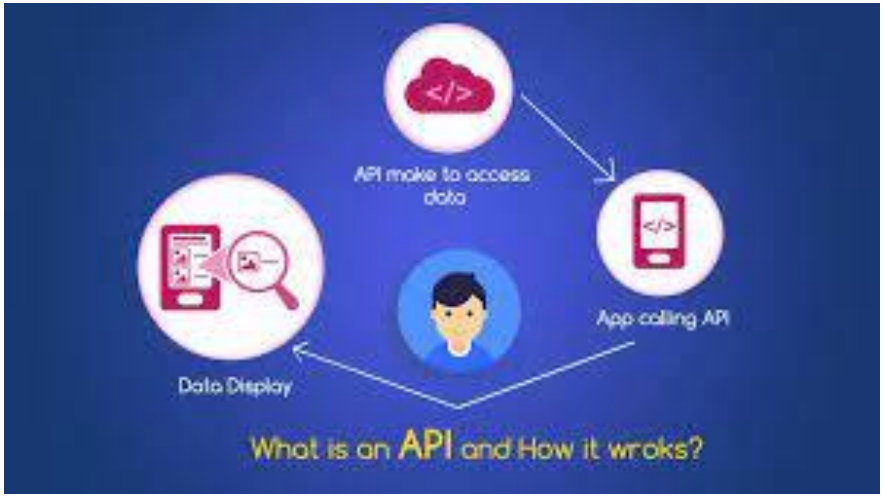
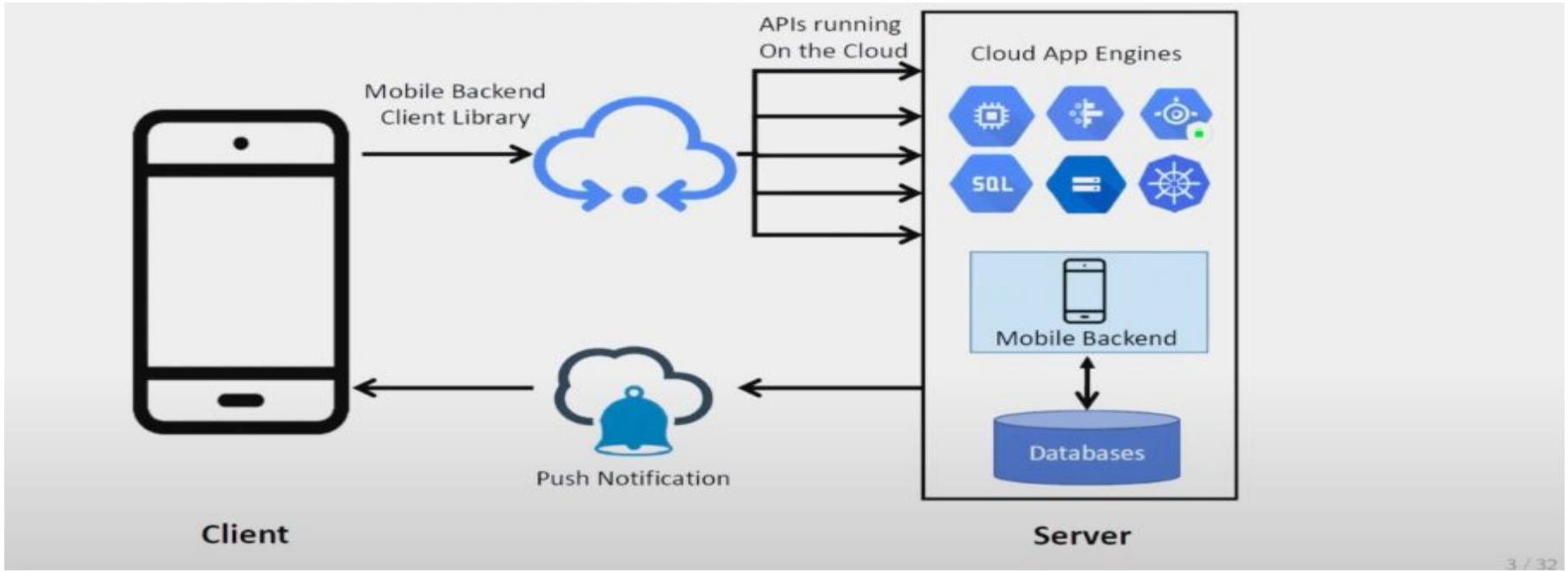
Introduction

What is an API?

1. Application Programming Interfaces
2. Software to Software Interfaces
3. Microservices Communication



The Mobile Backend as a Service (mBaaS)



How does an API Function?

An API Functions using a request verb

1. GET : To retrieve a resource
2. POST : To create a new resource
3. PUT : To edit or update an existing resource
4. DELETE : To delete a resource

Introduction

What is an API?

Standard GET Response:

GET https://developer.nrel.gov/api/alt-fuel-stations/v1/nearest.json?api_key=XXXXXXXXX&location=Clemson+SC

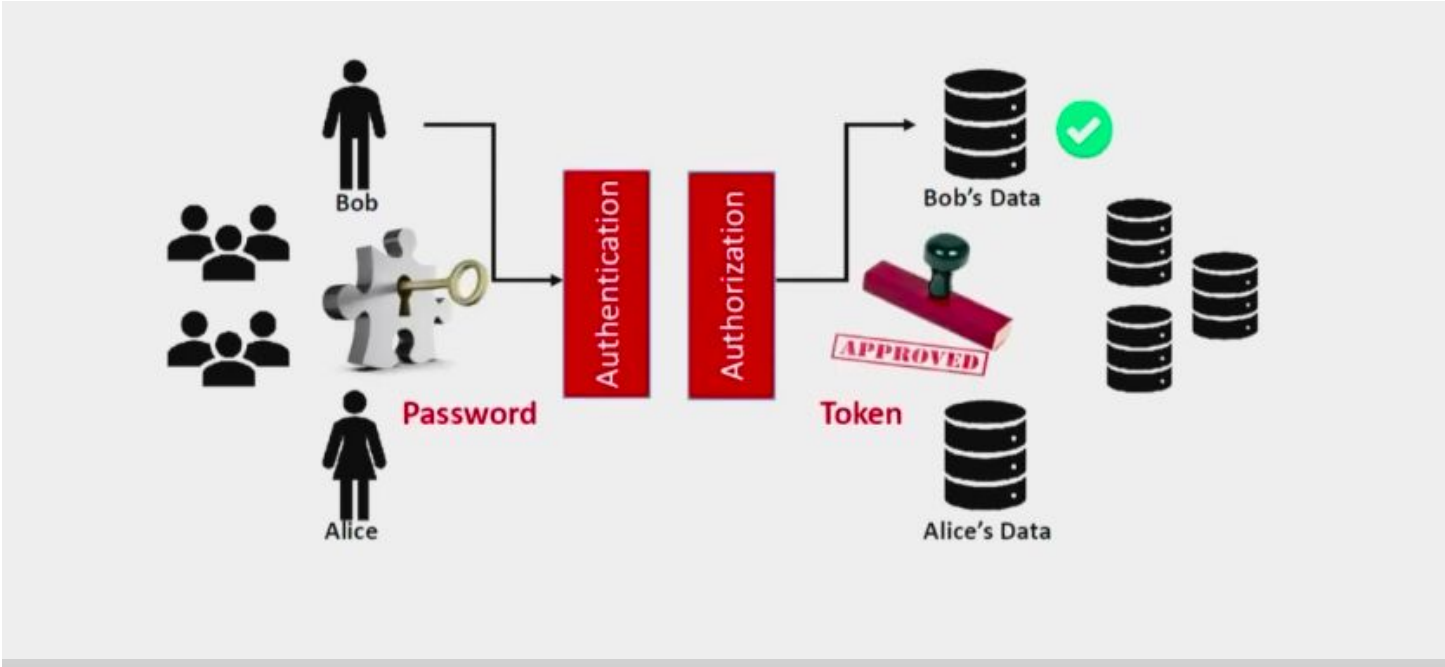
IF exists : HTTP Response 200(OK)

IF Doesn't exist: HTTP Response 404(Not Found)

Security in APIs

- As Data flows through the API, Security is of the utmost importance to present data leakage.
- API are obvious entry points for attackers to break into the system
- Handling requests to resources that aren’t allowed.
- Field-Level access control : What should be visible to which user?
- Using Postman to verify the results of the vulnerabilities.

Data Leakage as an Access Control Problem



mBaas Cloud Providers

Crawling the Web

Using scrapy for finding the most used apps and then extracting the apk files of those apps.

Applications in our dataset

```
C:\Users\sshri\Desktop\Tool>cd api_key_detector

C:\Users\sshri\Desktop\Tool\api_key_detector>ls
Boilr.apk              Gardine.apk       LeafPic.apk    Paseo.apk          Trekarta.apk           WaniDoku.apk
Calendula.apk          Gen_authtoken.py  Metronome.apk  PoetAssistant.apk  TriPeaks.apk           Yokatta.apk
FediPhoto-Lineage.apk  JitsiMeet.apk     Nonocross.apk  SimplySolid.apk    ValueSetAnalysis.java

C:\Users\sshri\Desktop\Tool\api_key_detector>
```

Reverse engineered the files

For checking the vulnerable code.

```
/* renamed from: d */
private static int m15766d() {
    SecureRandom secureRandom = new SecureRandom();
    byte[] bArr = new byte[4];
    byte b = 0;
    while (b == 0) {
        secureRandom.nextBytes(bArr);
        b = ((bArr[0] & Byte.MAX_VALUE) << Ascii.CAN) | ((bArr[1] & 255) << Ascii.DLE) | ((bArr[2] & 255) << 8) | (bArr[3] & 255);
    }
    return b;
}

public static KeysetManager withEmptyKeyset() {
    return new KeysetManager(Keyset.newBuilder());
}

public static KeysetManager withKeysetHandle(KeysetHandle keysetHandle) {
    return new KeysetManager((Keyset.Builder) keysetHandle.m50333f().toBuilder());
}

@Deprecated
public synchronized KeysetManager add(KeyTemplate keyTemplate) throws GeneralSecurityException {
    addNewKey(keyTemplate, false);
    return this;
}
```

```
KeyProvider23() {
}

public synchronized Key retrieveKey(String str) throws KeyNotFoundException {
    Key key;
    try {
        KeyStore instance = KeyStore.getInstance(ANDROID_KEY_STORE_NAME);
        instance.load((KeyStore.LoadStoreParameter) null);
        if (instance.containsAlias(str)) {
            Log log = logger;
            log.debug("AndroidKeyStore contains keyAlias " + str);
            logger.debug("Loading the encryption key from Android KeyStore.");
            key = instance.getKey(str, (char[]) null);
            if (key == null) {
                throw new KeyNotFoundException("Key is null even though the keyAlias: " + str + " is present in " + ANDROID_KEY_STORE_
            }
        } else {
            throw new KeyNotFoundException("AndroidKeyStore does not contain the keyAlias: " + str);
        }
    } catch (Exception e) {
        throw new KeyNotFoundException("Error occurred while accessing AndroidKeyStore to retrieve the key for keyAlias: " + str, e);
    }
    return key;
}
```

Checking any false positives

- Ran the tool against the dataset.
- Confirmed that no false positives exist while scanning for the cloud providers in the apps.
- Results were confirmed by cross checking it which our results found after reverse engineering the files.

Extracted Keys

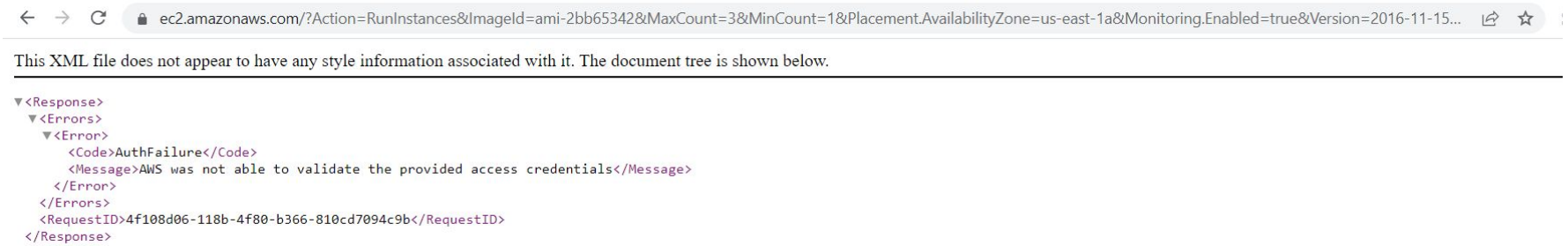
```
C:\Users\sshri\Desktop\Tool\api_key_detector>javac ValueSetAnalysis.java

C:\Users\sshri\Desktop\Tool\api_key_detector>java ValueSetAnalysis
0.06817095,0.00014711,0.00681442,ISSN8yYzHk84Y6PfMd_1BvhNCBzgfQxcSP5bx--ZMil0Qmkh/VU2bBUpYulVyxgwh5nY5s
0.06817095,0.00014711,0.00681442,c487ba1b6d536aec1f3e48bffbe3532c1f78b1a2
0.06817095,0.00014711,0.00681442,e1d0c9ce505b1822d97a34ade0107d241d82ec74fd522e4963e602c
0.06817095,0.00014711,0.00681442,oxBmfms2SrMeEB5iaQUFR7VCnlYFxNY3jLHPGYXMd7fe81e4f62df3e
0.06817095,0.00014711,0.00681442,AuhXCurI1rioe8xbkzHpXnZQ3D993ibcHXaCJsc56_7OSm1vTYgeXHOuo/BbXz-tnClC85
0.06817095,0.00014711,0.00681442,075b4a0782c168c8c197691365e8a6c65ed13d410fd10a68a2068ba
0.06817095,0.00014711,0.00681442,NHzD9JoV24aI5sDmZo/Kbex7Fa6d8eJz7DBSRI0g
0.06817095,0.00014711,0.00681442,dfdf3928dd6d77c62d290162ccdb61bbfda041ddfb6d70bed45eef6
0.06817095,0.00014711,0.00681442,0ad60a37fb035d1d9c1c0094c1a558848a156cb167c33a36d6e2cff
0.06817095,0.00014711,0.00681442,0cdcUO7Pn0OFHAHuDdZcwQDfAHMnARUT7CRIWJ9m
0.06817095,0.00014711,0.00681442,eyJ0eXAi0iJKV1QiLCOhbGciliJIUzI1NiJ9.eyJlbwFpbCI6ImFkb2
0.06817095,0.00014711,0.00681442,zS/3eq7qguYNaWw83NmfY7fIcCkqw_kPwOn8lZVybaxNK_VsIh7Q7Xw93cZw4GLAUBJs4l
0.06817095,0.00014711,0.00681442,KFsukQJ8FpgQu9u8qiga0qqDDydNh5K5o9vzQM6JpJwvBaD7mPgp7RW5ZLZQer6GDr_QtQ
0.06817095,0.00014711,0.00681442,YfPlvOe6pzN9h3Ceq0sO2J/dra747RxXP0xyNcJG
0.06817095,0.00014711,0.00681442,Led8vxbES1fs1Lv_0jYl0-y1lsCi07W0sutuHdOJgUbcVbur/Bl0aMZ-w0vXSikmQwMKfF

C:\Users\sshri\Desktop\Tool\api_key_detector>
```

Querying with the cloud providers endpoint

- Using the extracted key, one of the Get request made to AWS.
- This shows that there are no Misconfigured AWS Authorization Rules.



Querying to AWS database using the key

- Get request made to AWS simple DB.
- This shows that this is the root key that was present in the mobile apk. The attacker can easily extract this. Thus, causing data leakage.
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Results of our analysis

Name	Cloud Service Used	App Description and Functionality	Privacy Sensitive
Yokatta	AWS	Flashcards based language learning app	✗
Simply Solid	AWS	Pick a solid color as your homescreen background color	✓
Boilr	AWS	Android app which monitors Bitcoin, cryptocurrencies, cryptoassets, futures and options, triggering price alarms	✗
Metronome	AWS	Professional tool to help all musicians play with flawless accuracy	✗
TriPeaks	AWS	Classic solitaire puzzle game	✓

Apps that use AWS as their backend service

Results of our analysis

Name	Cloud Service Used	App Description and Functionality	Privacy Sensitive
Calendula	Firebase	Manage your medical prescriptions through a simple and intuitive interface	❌
WaniDoku	Firebase	Japanes leaning app	❌
Poet Assistant	Firebase	A set of offline tools to help with writing poems	❌
Nonocross	Firebase	Simple number puzzle game based around grids	✔
Paseo	Firebase	Step counting app	❌

Apps that use Google Firebase as their backend service

Results of our analysis

Name	Cloud Service Used	App Description and Functionality	Privacy Sensitive
FediPhoto-Lineage	Azure	Quickly post photos	✗
Trekarta	Azure	Designed for hiking, geocaching, off-roading, cycling, boating and all other outdoor activities	✓
LeafPic	Azure	A fluid, material-designed alternative gallery	✗
Gardine	Azure	A minimalistic one-touch app switcher	✓
Jitsi Meet	Azure	Instant video conferences efficiently adapting to your scale	✗

Apps that use Microsoft Azure as their backend service

Thankyou (: