Anchored

Description

- A client asked me to check if I can intercept the https request and get the value of the secret parameter that is passed along with the user's email. The application is intended to run in a non-rooted device. Can you help me find a way to intercept this value in plain text.

Objective

- `Decompile th APK file, and change the network security configuration to intercept the HTTPS request and get the flag.`

Difficulty

- `Medium`

Flag

- `HTB{UnTrUst3d_C3rT1f1C4T3s}`

Release:

- /release/Anchored.zip
  (`09079c000742b01298c6c57232fb1d0f9a6c488374f2325b537d238c0d510b3a`)

Prerequisites

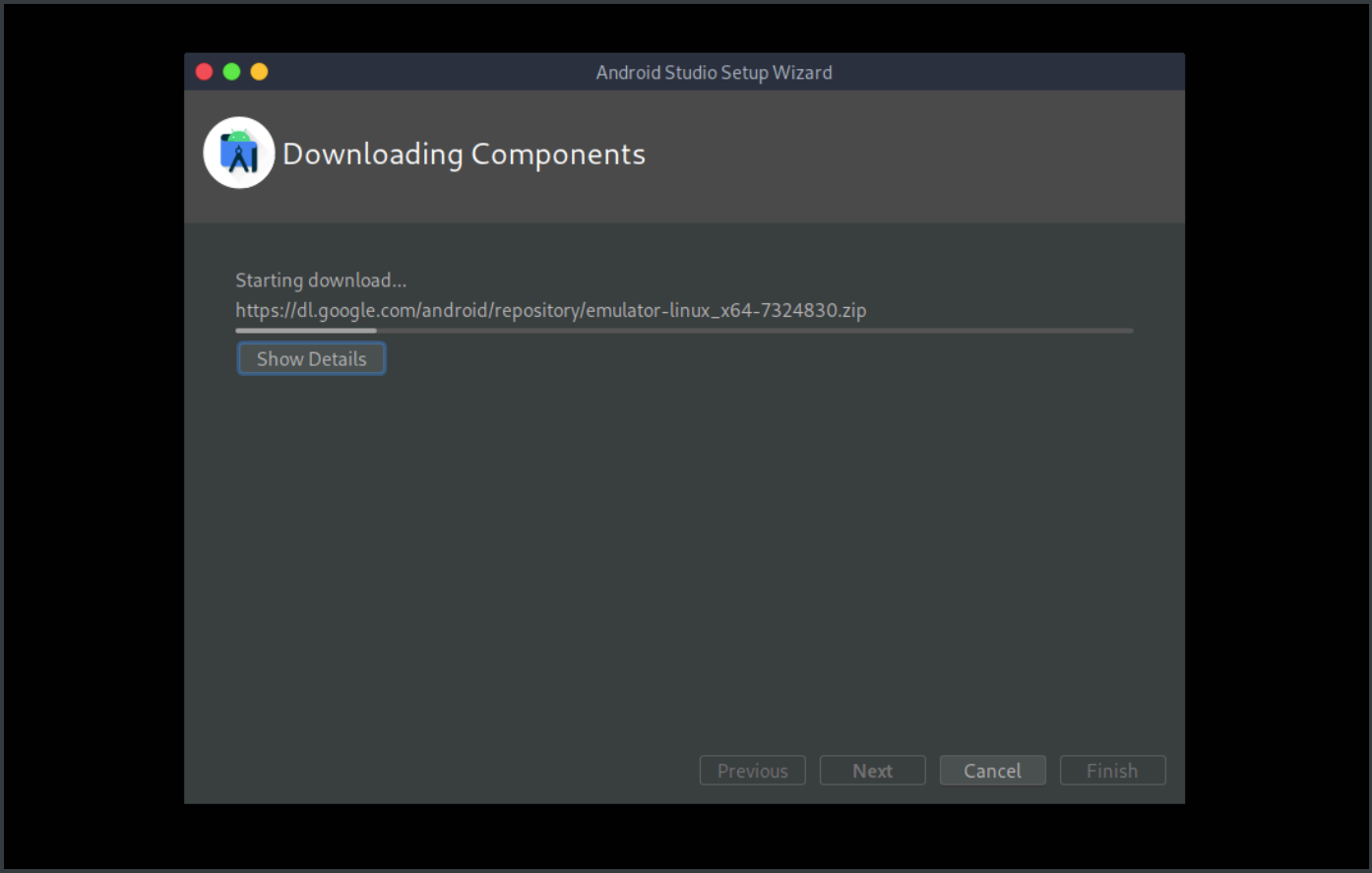
- A virtual Android image like Android-x86 running on Virtual Box or VMware or another Android emulator, running with the Developer mode on.
- Alternatively, a real android device connected via USB, running with the Developer mode on.

Challenge:

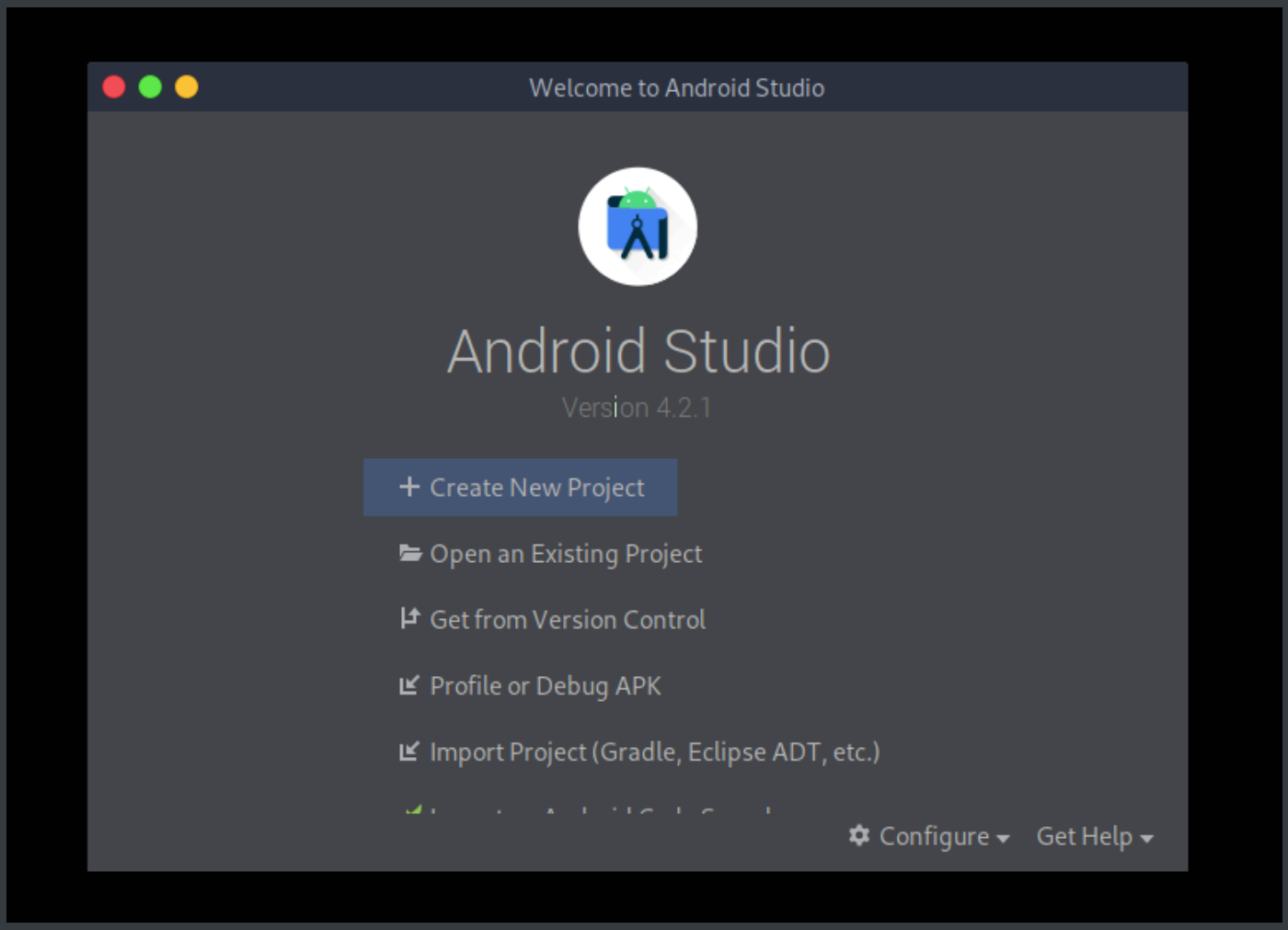
Unzipping the `Anchored.zip` file reveals the file `Anchored.apk`. In order to run the `Anchored.apk` file, we have to set up an Android emulator. To achieve this, we are going to use Android Studio IDE.

```
wget https://redirector.gvt1.com/edgedl/android/studio/ide-zips/4.2.1.0/android-studio-ide-202.7351085-linux.tar.gz
tar xvzf android-studio-ide-202.7351085-linux.tar.gz
sh android-studio/bin/studio.sh
```

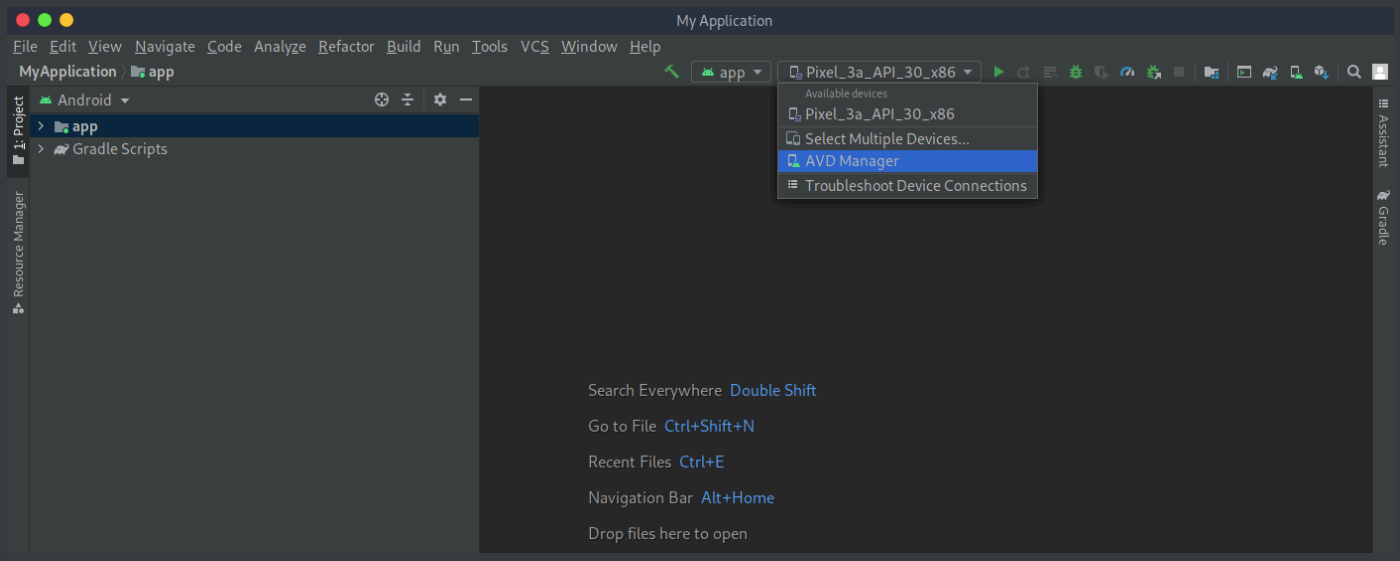
On the setup wizard we click `OK`, then we click on `Next`, and finally click on `Finish`. Next, we wait for the Android Studio to download the components.



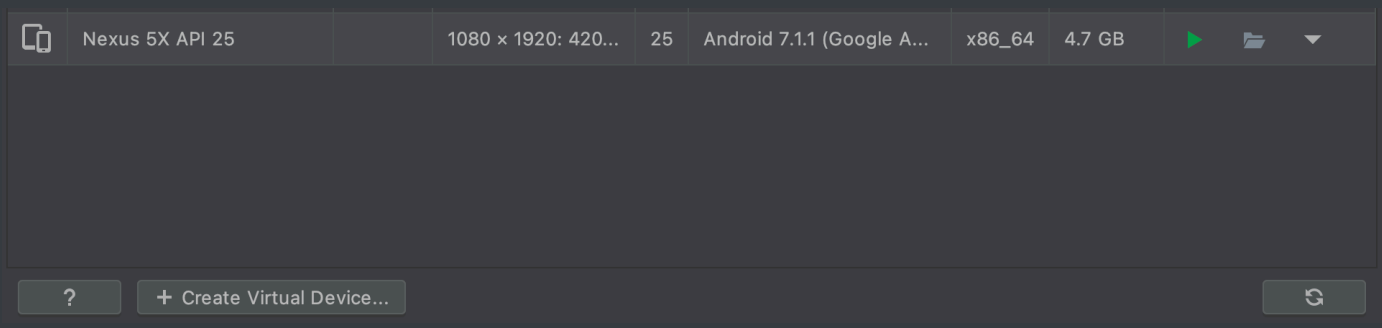
Once it's done, we click `Finish` once again.



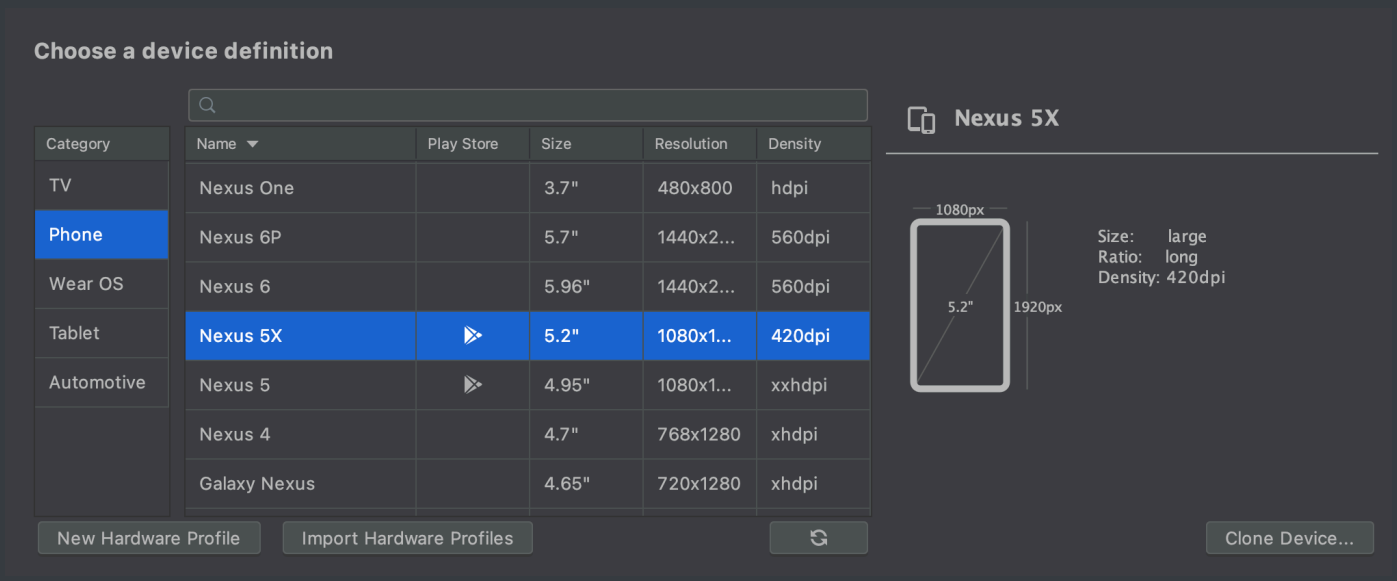
Then we click `Next` and finally we click on `Finish`. Now that we have created a new project, we wait for some more files to get downloaded automatically from the IDE. When that's done, click on the top centre of the IDE and select `AVD Manager`.



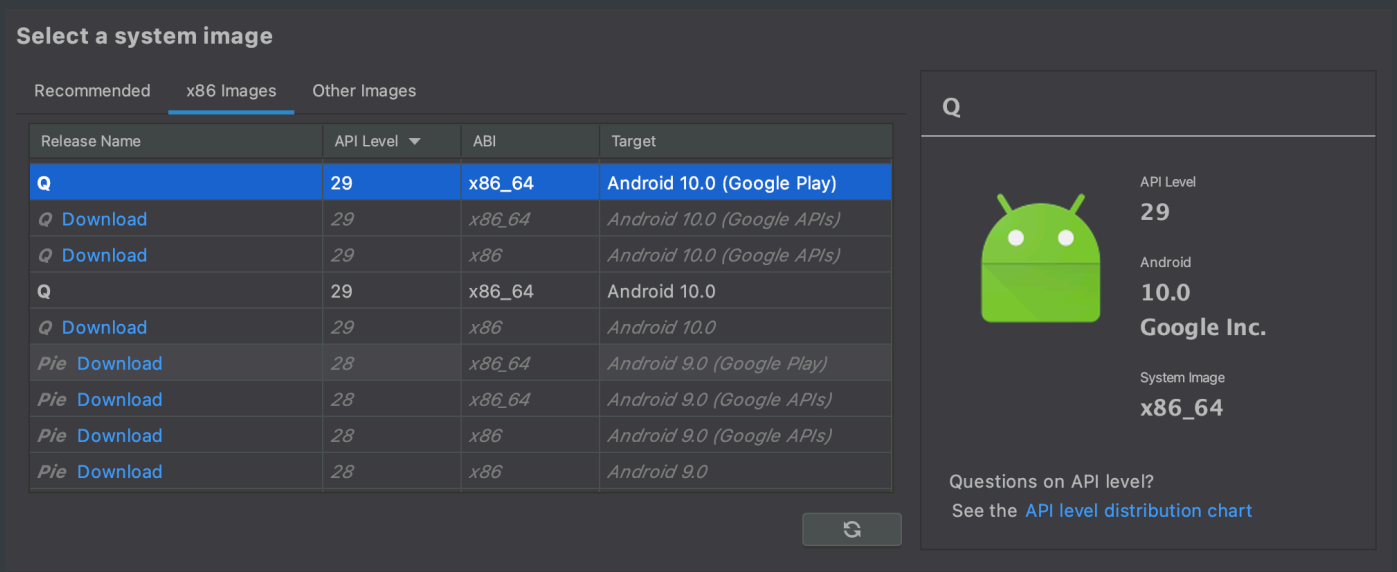
On the AVD Manager menu, click on the `Create Virtual Device...` button to create a new device.



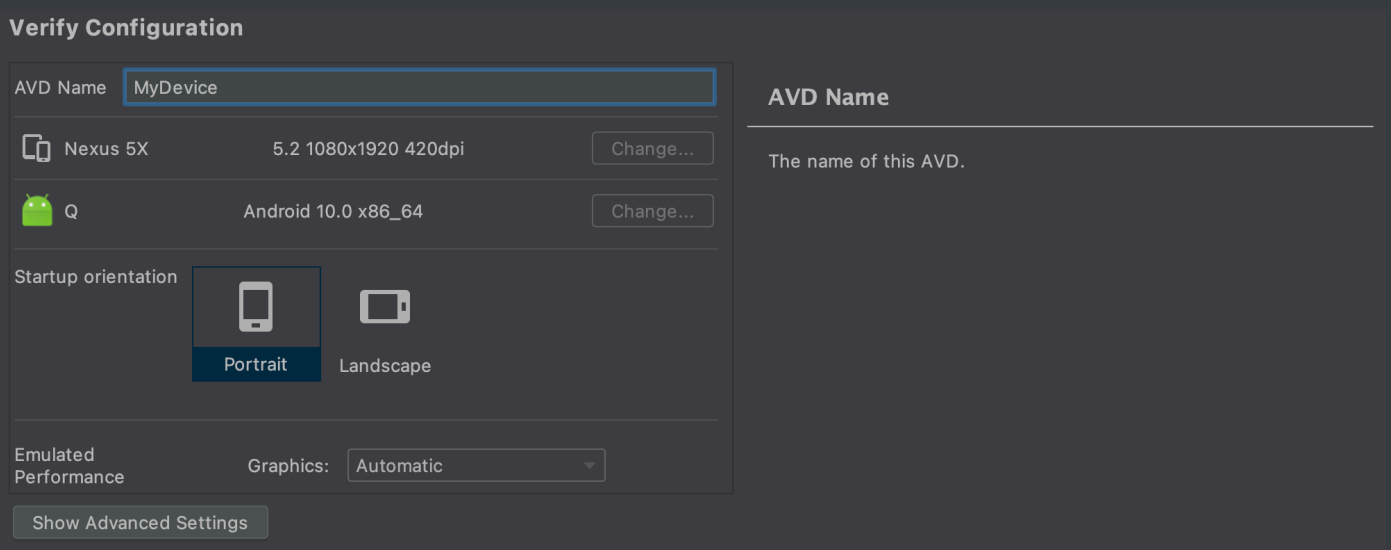
On the next window, we choose a device. In this example, we will be using a `Nexus 5X` device.



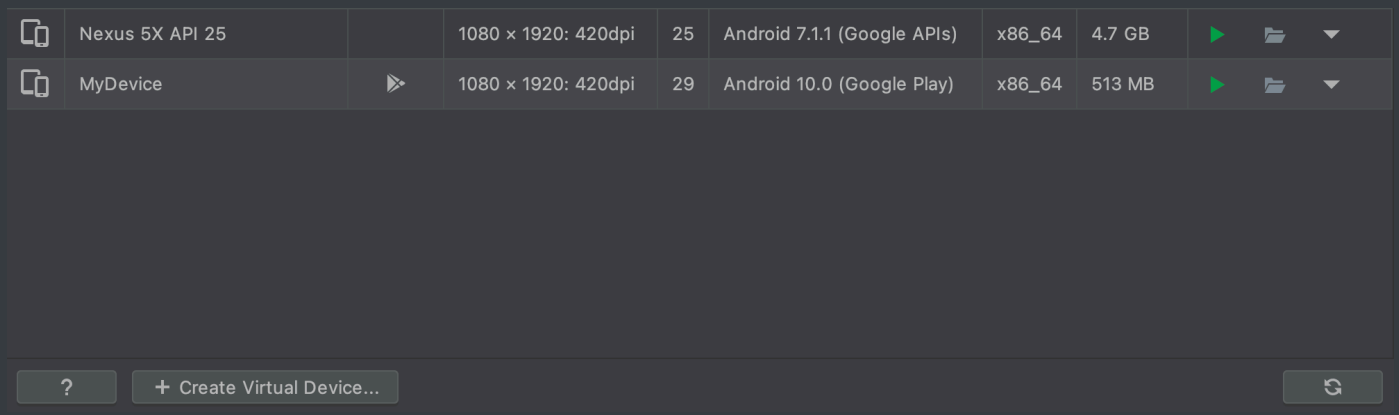
Once we have chose the device, we click `Next`. In the next window, we click on the `x86 Images` tab, and select an image that includes `Google Play`. That also means that the device wont be rooted, as it's also suggested from the description. In this example we are going to use a `x86_64` image with `API Level 29`.



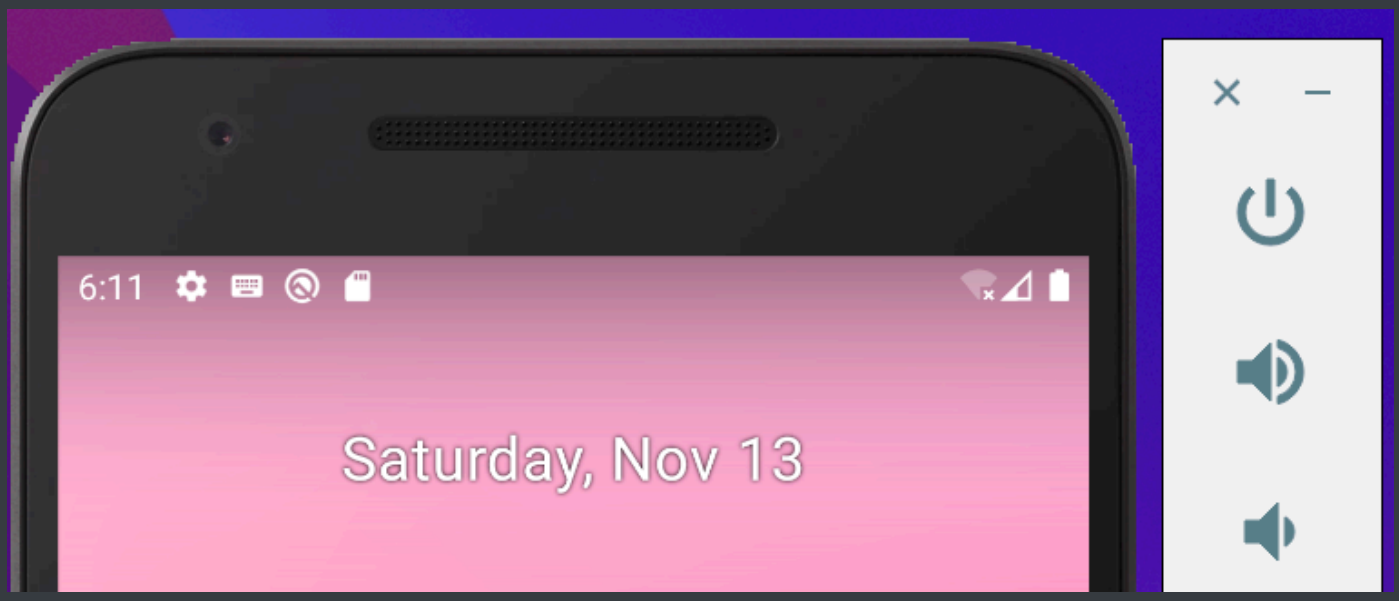
If it's not already downloaded, click on the `Download` link first. Then, select it and click `Next`. On the final window, name the device and click `Finsih`.

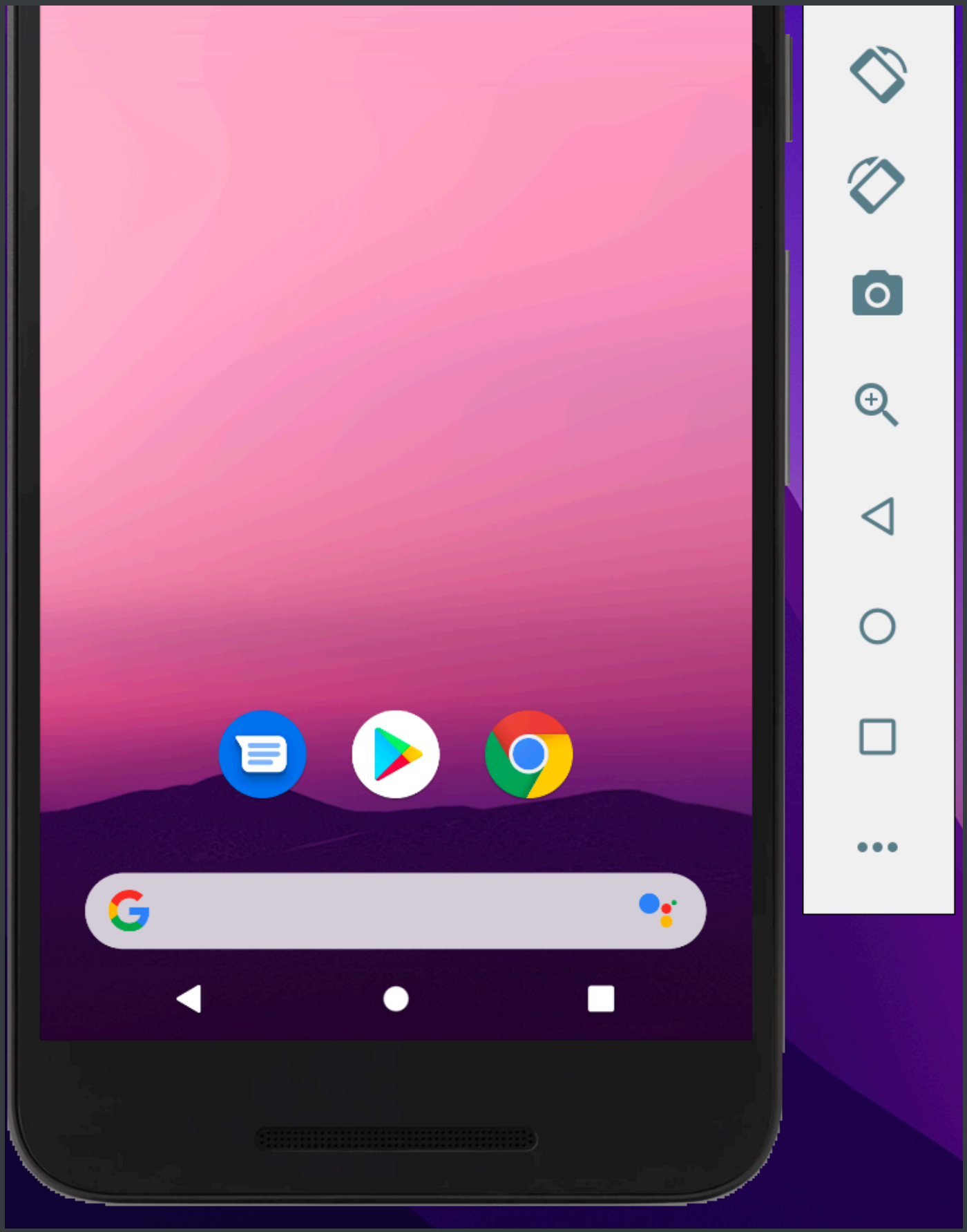


Finally, we can click on the green `play` button to start the emulator.



Once the device is started, It should be looking like this.





Next step, is to install `adb` so we can communicate with it.

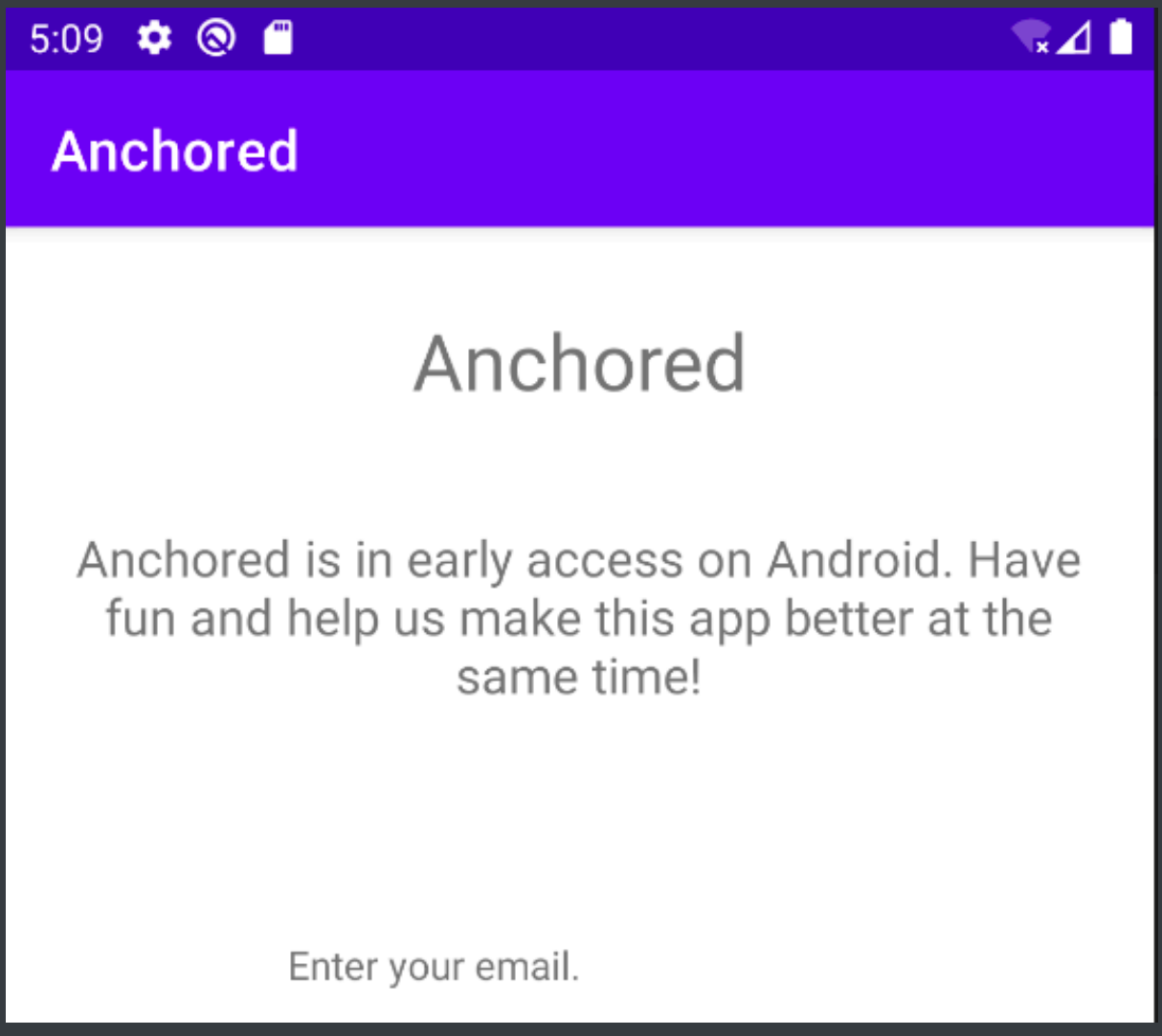
```
sudo apt install adb
```

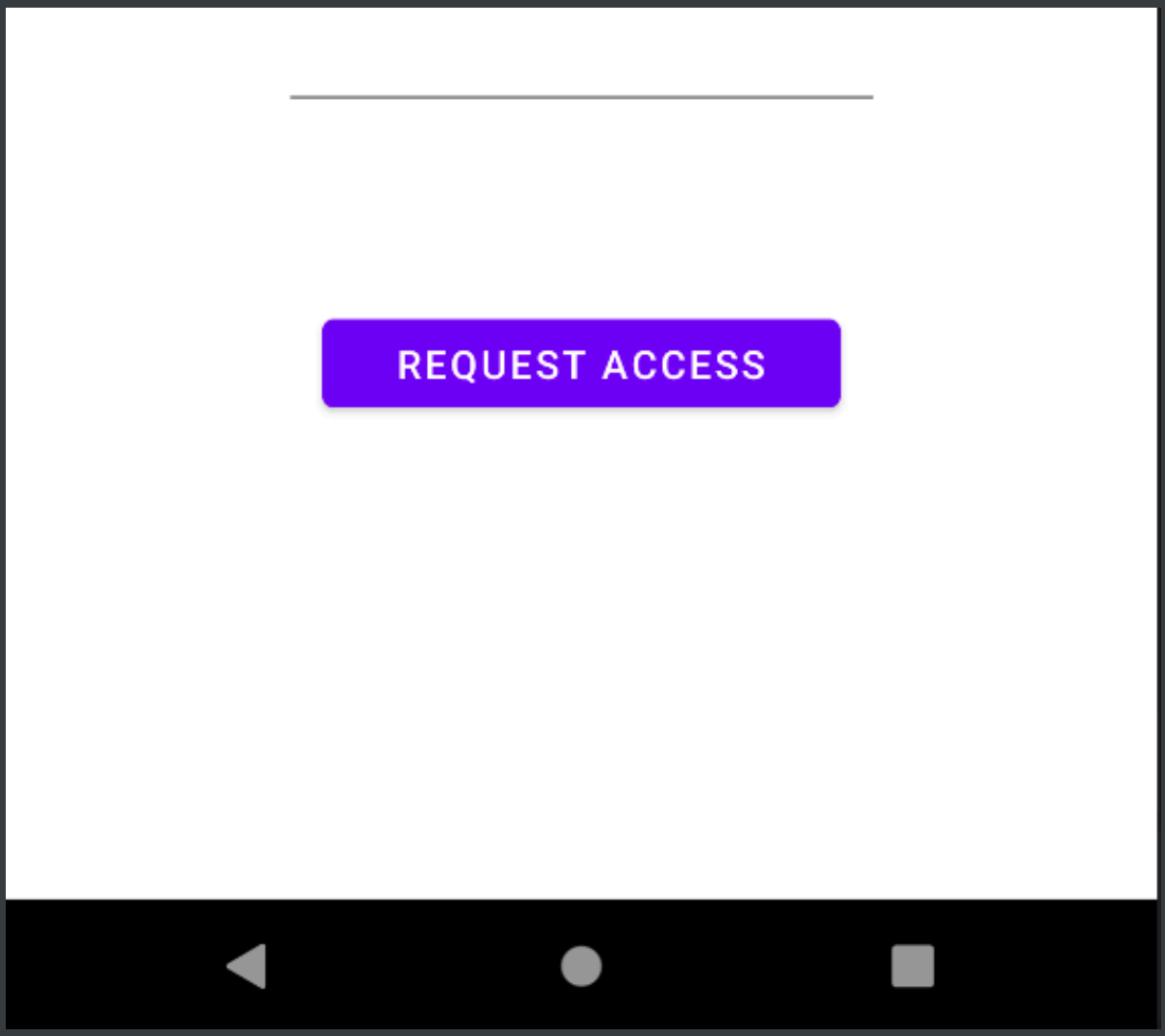
While the device is running, we can execute the following command to install the application on the device.

```
adb install Anchored.apk
```

```
adb install Anchored.apk
Performing Streamed Install
Success
```

We can now run the application on the Android device.



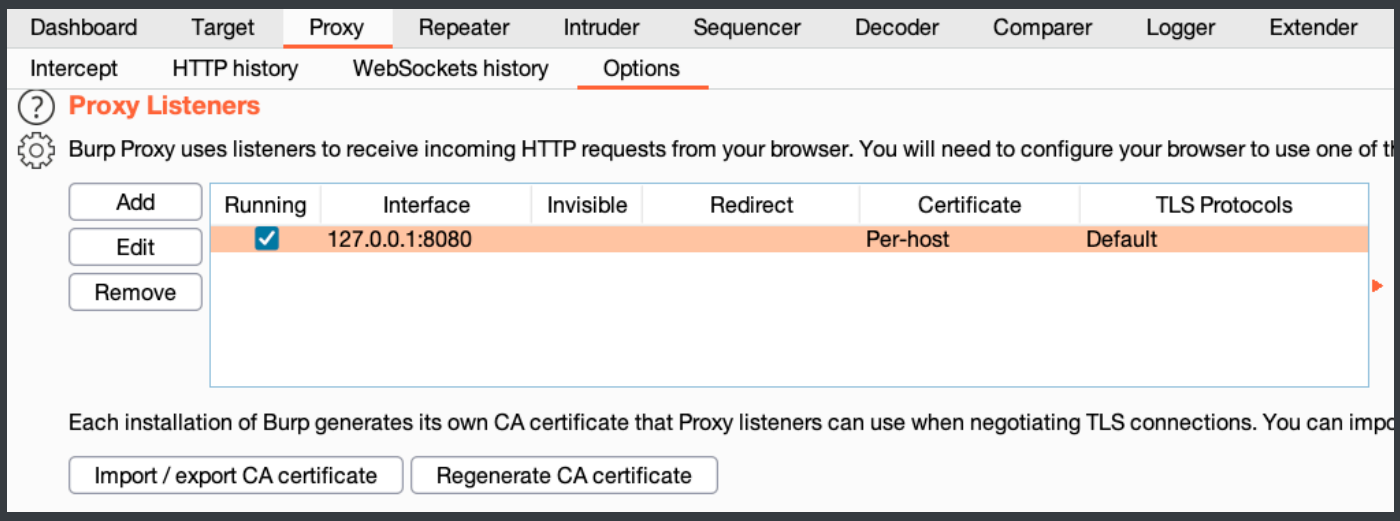


This app lets us put our email address in order to get early access. According to the description, we need to find a way to intercept the value of a secret parameter that is past during the HTTPS request. To do so, we need to set up Burp Suite working with the Android emulator. First, we type the following on the host machine to get the ip address.

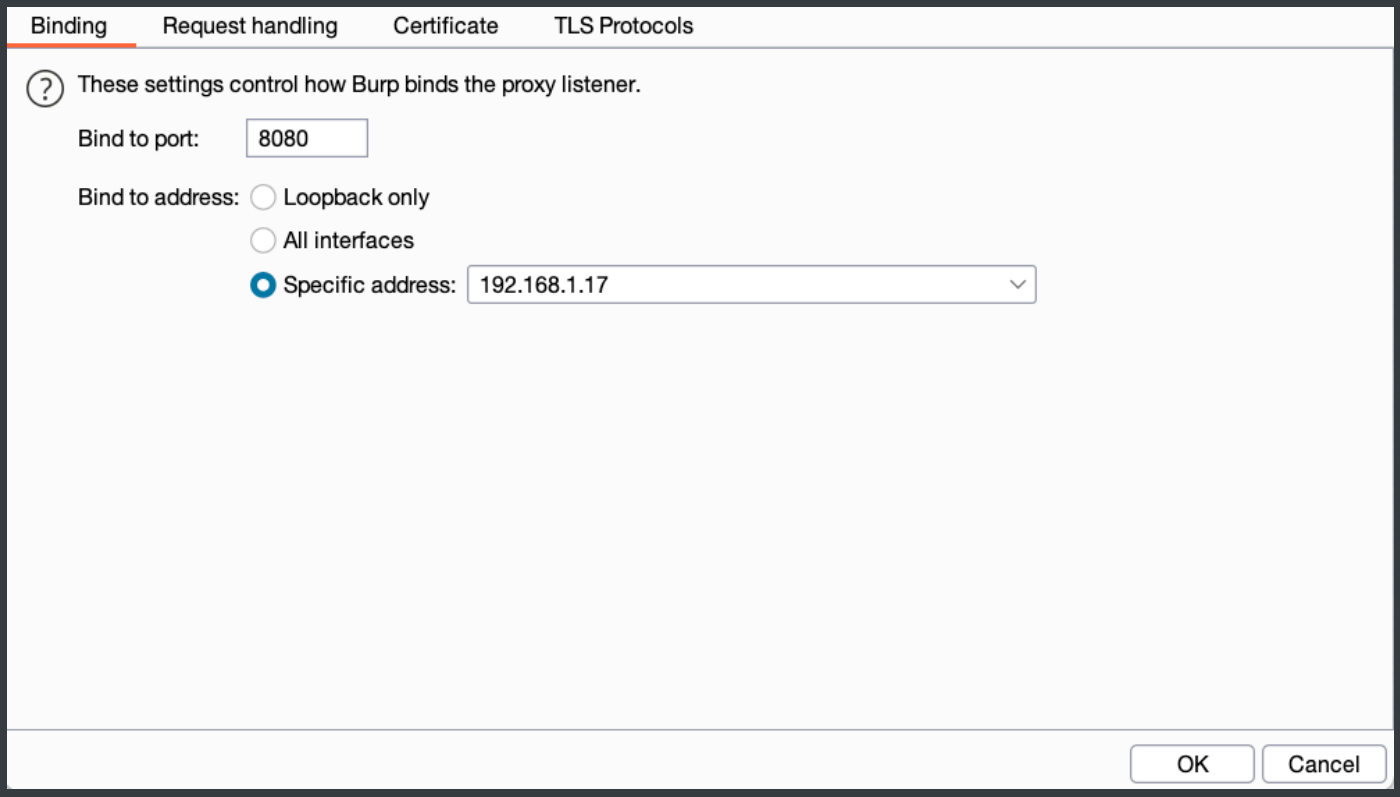
```
ifconfig
```

```
en0: flags=8863<UP,BROADCAST,SMART,RUNNING,SIMPLEX,MULTICAST> mtu 1500
<SNIP>
    inet 192.168.1.17 netmask 0xffffff00 broadcast 192.168.1.255
    nd6 options=201<PERFORMNUD,DAD>
    media: autoselect
    status: active
```

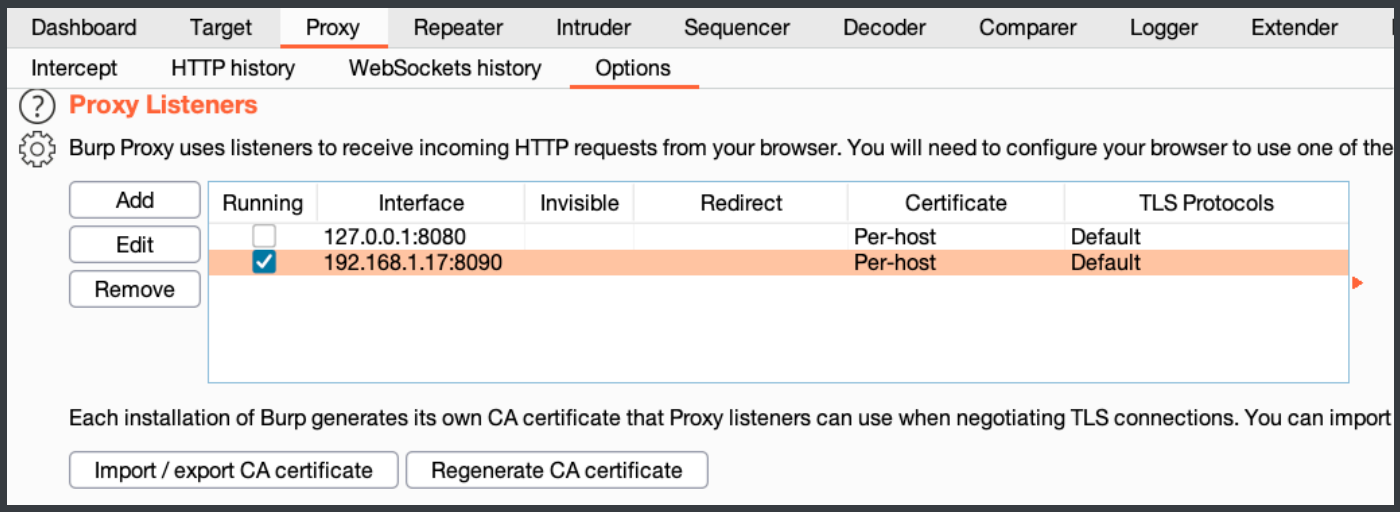
On the Burp Suit `Proxy` tab, go on `Options` and press the `Add` button under the `Proxy Listeners` section.



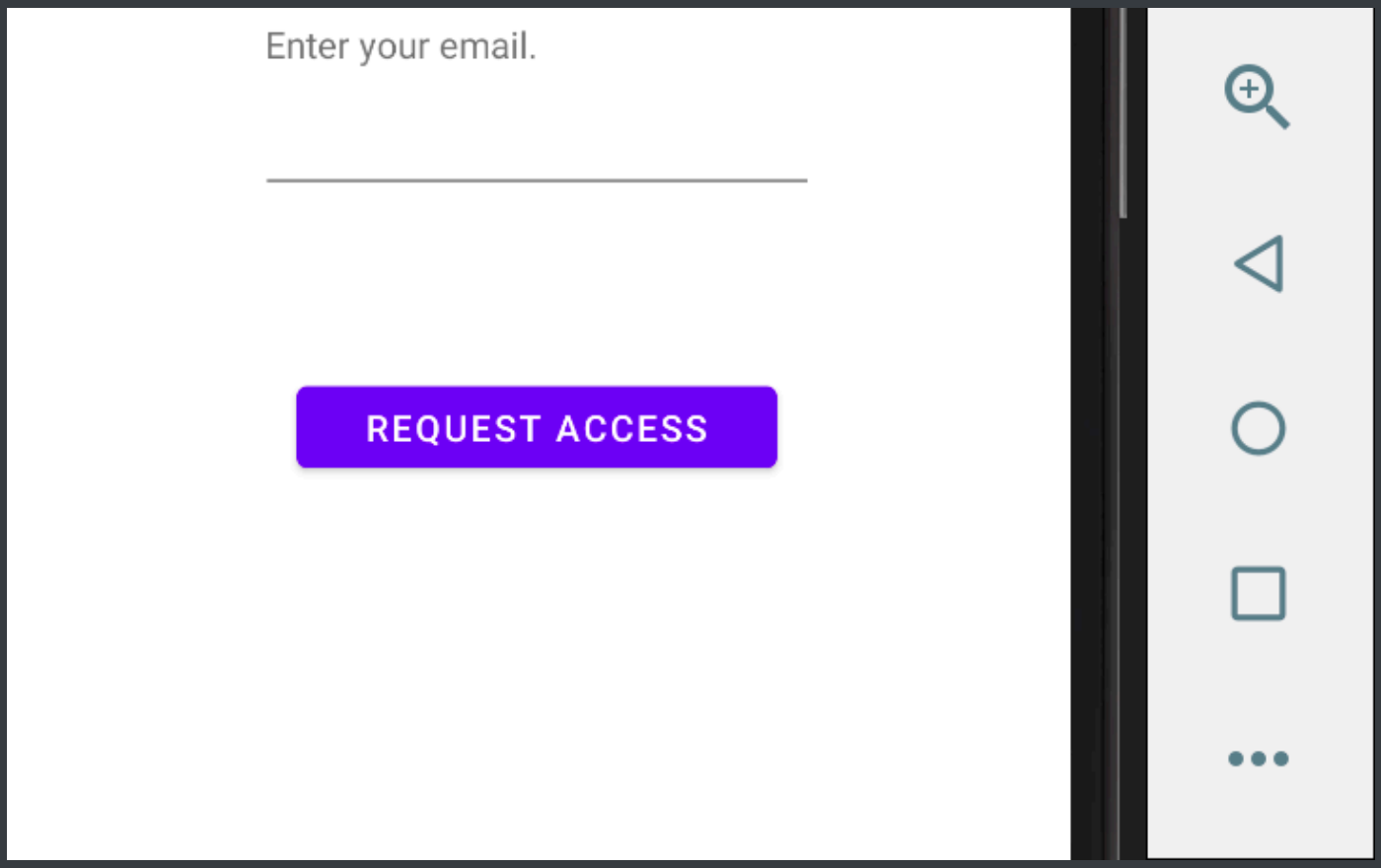
On the pop up window type the port `8090` and select the host's IP from the drop down menu.



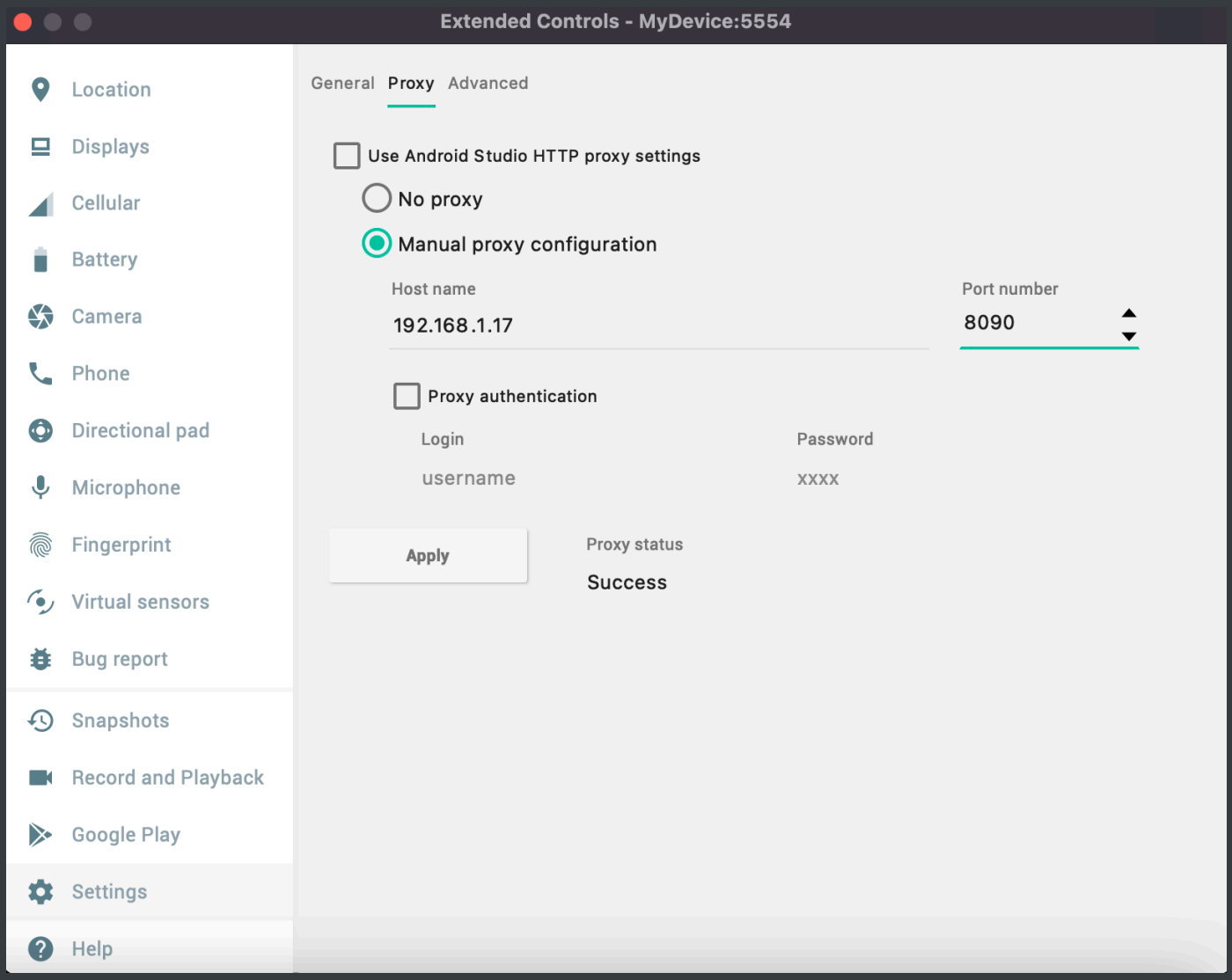
Click `OK` and make sure the new proxy listener is selected.



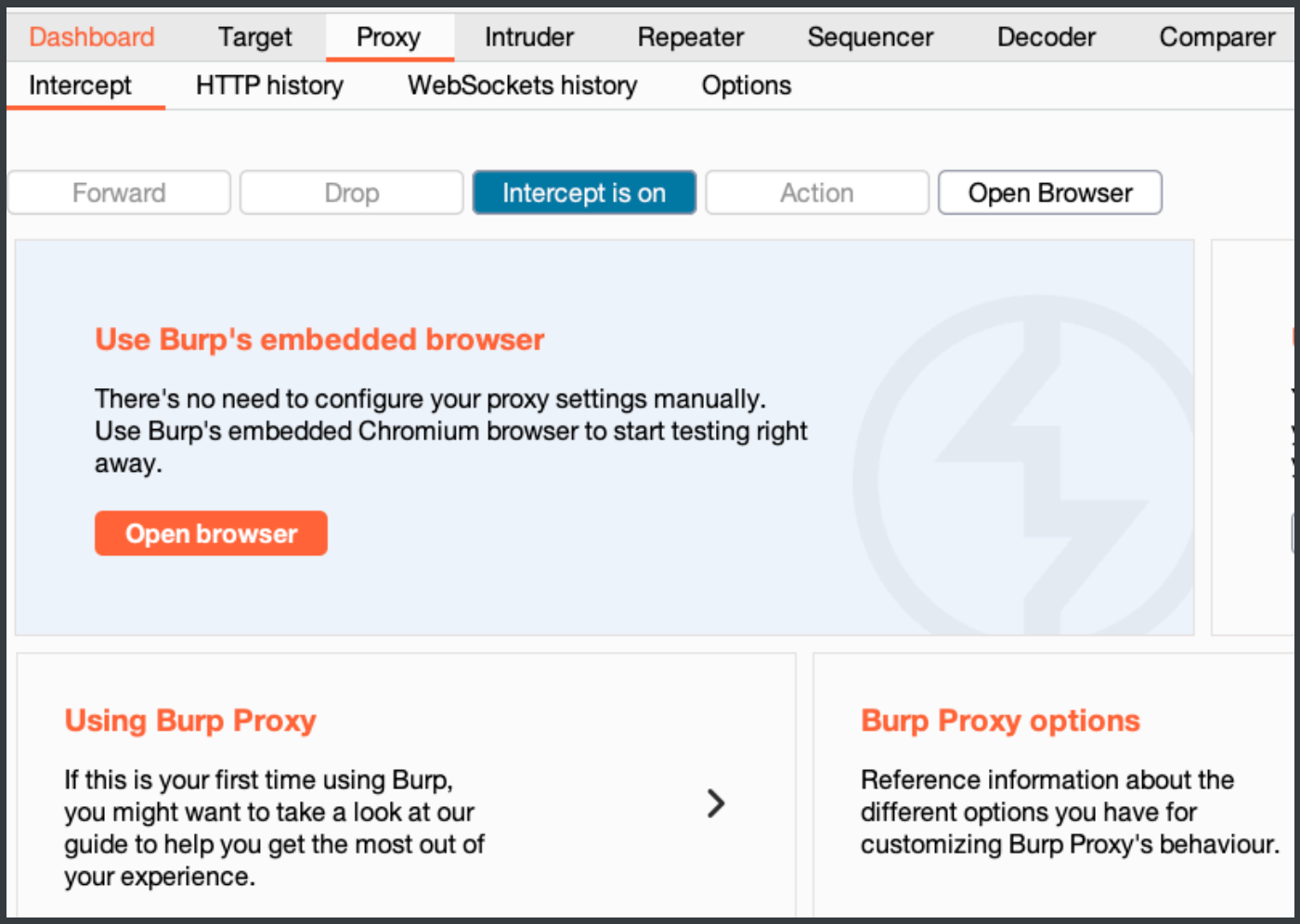
Back to the Android emulator, click the three dots from the vertical menu near the device.



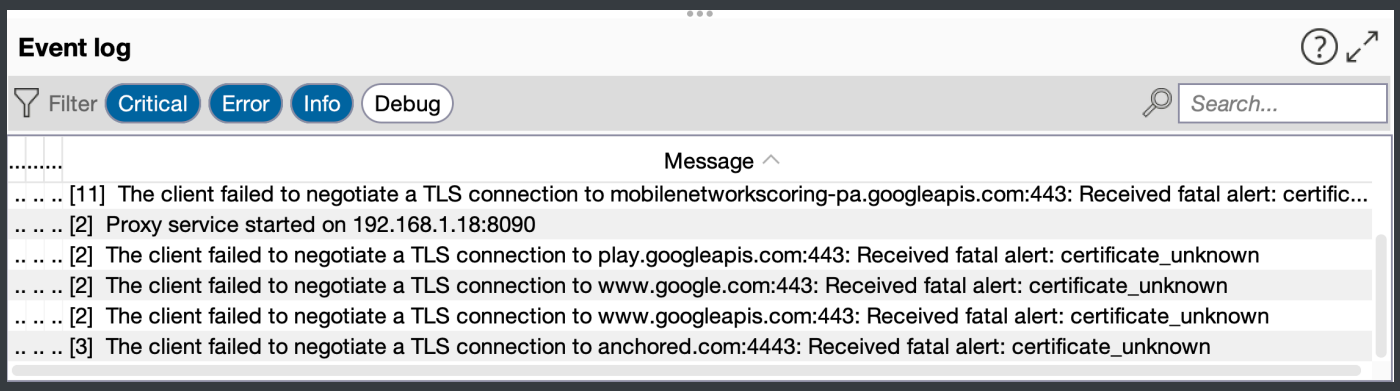
On the `Extended Controls` pop up window, click on settings. Then, uncheck the `Use Android Studio HTTP proxy settings`, and check the `Manual proxy configuration`. On the `Host name` field, add the host IP address, and on the `Port number` add `8090`. Finally click `APPLY`.



The `Proxy status` should say `Success`. If not, make sure that the `Intercept is on` button on the `Intercept` tab on Burp, is toggled on. Finally, fill in your email address on the app, and click the `REQUEST ACCESS` button. The request should now be intercepted on Burp.



As we can see, it failed to intercept the request and the tab `Dashboard` is now toggled on. Navigating to the `Dashboard` tab, we can see that the alert `The client failed to negotiate a TLS connection to anchored.com:4443: Received fatal alert: certificate_unkown` has been raised, and it's visible in the last line.



This means that the connection is secure and we don't provide the specific certificate that is used by the app. Let's decompile the `Anchored.apk` file using Apktool, and see if we can get any useful information about the app.

```
java -jar apktool_2.5.0.jar d Anchored.apk
```

```
java -jar apktool_2.5.0.jar d Anchored.apk
I: Using Apktool 2.5.0 on Anchored.apk
I: Loading resource table...
I: Decoding AndroidManifest.xml with resources...
I: Loading resource table from file: /home/bertolis/.local/share/apktool
/framework/1.apk
I: Regular manifest package...
I: Decoding file-resources...
I: Decoding values */* XMLs...
I: Baksmaling classes.dex...
I: Copying assets and libs...
I: Copying unknown files...
I: Copying original files...
```

Decompilation of the `Anchored.apk` file reveals the `./Anchored/AndroidManifest.xml`.

```
cat ./Anchored/AndroidManifest.xml
```

```
cat ./Anchored/AndroidManifest.xml
<?xml version="1.0" encoding="utf-8" standalone="no"?><manifest
xmlns:android="http://schemas.android.com/apk/res/android"
android:compileSdkVersion="31" android:compileSdkVersionCodename="12"
package="com.example.anchored" platformBuildVersionCode="31"
platformBuildVersionName="12">
    <uses-permission android:name="android.permission.INTERNET"/>
    <application android:allowBackup="true"
android:appComponentFactory="androidx.core.app.CoreComponentFactory"
android:icon="@mipmap/ic_launcher" android:label="@string/app_name"
android:networkSecurityConfig="@xml/network_security_config"
android:roundIcon="@mipmap/ic_launcher_round" android:supportsRtl="true"
android:theme="@style/Theme.Anchored">
        <activity android:exported="true"
android:name="com.example.anchored.MainActivity">
            <intent-filter>
                <action android:name="android.intent.action.MAIN"/>
                <category
android:name="android.intent.category.LAUNCHER"/>
            </intent-filter>
        </activity>
    </application>
</manifest>
```

`AndroidManifest.xml` seems also to include `android:networkSecurityConfig="@xml/network_security_config`. Reading the content of this file reveals the following.

```
cat ./Anchored/res/xml/network_security_config.xml
```

```
cat ./Anchored/res/xml/network_security_config.xml
<?xml version="1.0" encoding="utf-8"?>
<network-security-config>
    <domain-config cleartextTrafficPermitted="false">
        <domain includeSubdomains="true">anchored.com</domain>
        <trust-anchors>
            <certificates src="@raw/certificate" />
        </trust-anchors>
    </domain-config>
</network-security-config>
```

As the `network_security_config.xml` file indicates, the app reads the ssl certificate for the domain `anchored.com`, from the file `@raw/certificate`. This path in the android project structure, is the path `project_name/res/raw/certificate`. We can check if the certificate is in this path by issuing the following command.

```
ls -l ./Anchored/res/raw/
```

```
ls -l Anchored/res/raw/
total 4
-rw-r--r-- 1 bertolis bertolis 1359 Νοε  14 18:31 certificate.pem
```

In order to intercept the request and get the value of the parameter in plain text, we could issue a new certificate using Burp, add it in the user's `Trasted credentials` of the device, and finally include `<certificates src="user" />` in the `network_security_config.xml`. According to the offical documentation Network security configuration, there is a way to allow the app to trust any certificate that is included in the user's `Trasted credentials` of the device.

The source of CA certificates. Each certificate can be one of the following:

- a raw resource ID pointing to a file containing X.509 certificates. Certificates must be encoded in DER or PEM format. In the case of PEM certificates, the file *must not* contain extra non-PEM data such as comments.
- `"system"` for the pre-installed system CA certificates
- `"user"` for user-added CA certificates

The following snippet indicates that we can achieve this by including the line `<certificates src="user" />` into the `network_security_config.xml` file.

```
<base-config cleartextTrafficPermitted="true">
    <trust-anchors>
        <certificates src="system" />
        <certificates src="user" />
    </trust-anchors>
</base-config>
```

The `network_security_config.xml` should look like this.

```
cat Anchored/res/xml/network_security_config.xml
<?xml version="1.0" encoding="utf-8"?>
<network-security-config>
    <domain-config cleartextTrafficPermitted="false">
        <domain includeSubdomains="true">anchored.com</domain>
        <trust-anchors>
            <certificates src="user" />
            <certificates src="@raw/certificate" />
        </trust-anchors>
    </domain-config>
</network-security-config>
```

Then, we recompile the application by issuing the following command.

```
java -jar apktool_2.5.0.jar b Anchored
```

```
java -jar apktool_2.5.0.jar b Anchored
I: Using Apktool 2.5.0
I: Checking whether sources has changed...
I: Smaling smali folder into classes.dex...
I: Checking whether resources has changed...
I: Building resources...
I: Copying libs... (/lib)
I: Building apk file...
I: Copying unknown files/dir...
I: Built apk...
```

Before we run this on the Android device, we need to self sign it, otherwise it's not going to be executed. Issue the following commands in order to sign the file. Put a random password, first and last name, and press enter on the other fields as shown in the picture below. On the last field, type `yes`.

```
cd Anchored/dist/
keytool -genkey -keystore john.keystore -validity 1000 -alias john
```

```
keytool -genkey -keystore john.keystore -validity 1000 -alias john
Enter keystore password:
Re-enter new password:

Warning:
No -keyalg option. The default key algorithm (DSA) is a legacy algorithm
and is no longer recommended. In a subsequent release of the JDK, the
default will be removed and the -keyalg option must be specified.

What is your first and last name?
  [Unknown]:  john doe
What is the name of your organizational unit?
  [Unknown]:
What is the name of your organization?
  [Unknown]:
What is the name of your City or Locality?
  [Unknown]:
What is the name of your State or Province?
  [Unknown]:
What is the two-letter country code for this unit?
  [Unknown]:
Is CN=john doe, OU=Unknown, O=Unknown, L=Unknown, ST=Unknown, C=Unknown
correct?
  [no]:  yes

Generating 2,048 bit DSA key pair and self-signed certificate
(SHA256withDSA) with a validity of 1,000 days
    for: CN=john doe, OU=Unknown, O=Unknown, L=Unknown, ST=Unknown,
C=Unknown
```

The key has been generated successfully. Let's now use it to sign the APK file.

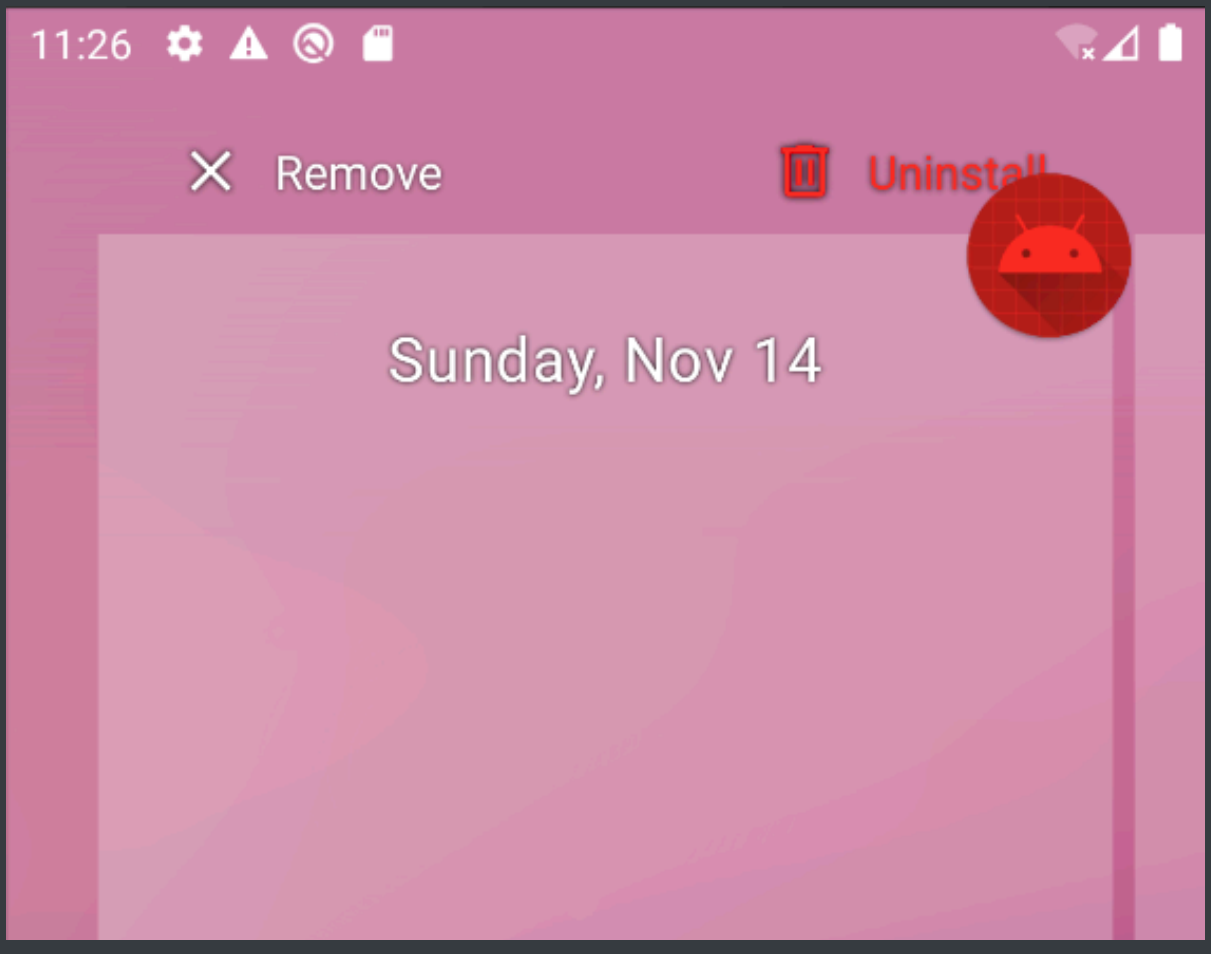
```
jarsigner -keystore john.keystore -verbose Anchored.apk john
```

```
jarsigner -keystore john.keystore -verbose Anchored.apk john
Enter Passphrase for keystore:
  adding: META-INF/MANIFEST.MF
  adding: META-INF/JOHN.SF
  adding: META-INF/JOHN.DSA
  signing: classes.dex
  signing: resources.arsc
  signing: AndroidManifest.xml

<SNIP>
jar signed.

Warning:
The signer's certificate is self-signed.
```

The new APK file has been successfully signed. Now we can try to run the edited application on our Android device. First we have to uninstall the previous application from the device, because the sign is different and it will throw an error. From the menu, tap and hold the application and drag it over the right corner that says `Uninstall`.

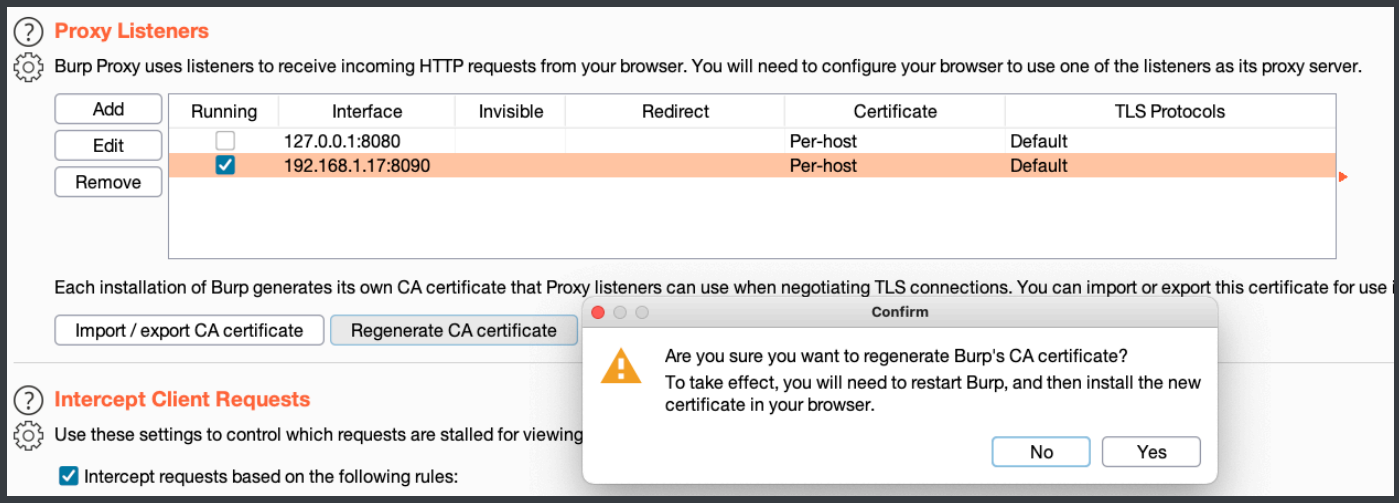


Then, install the new APK file.

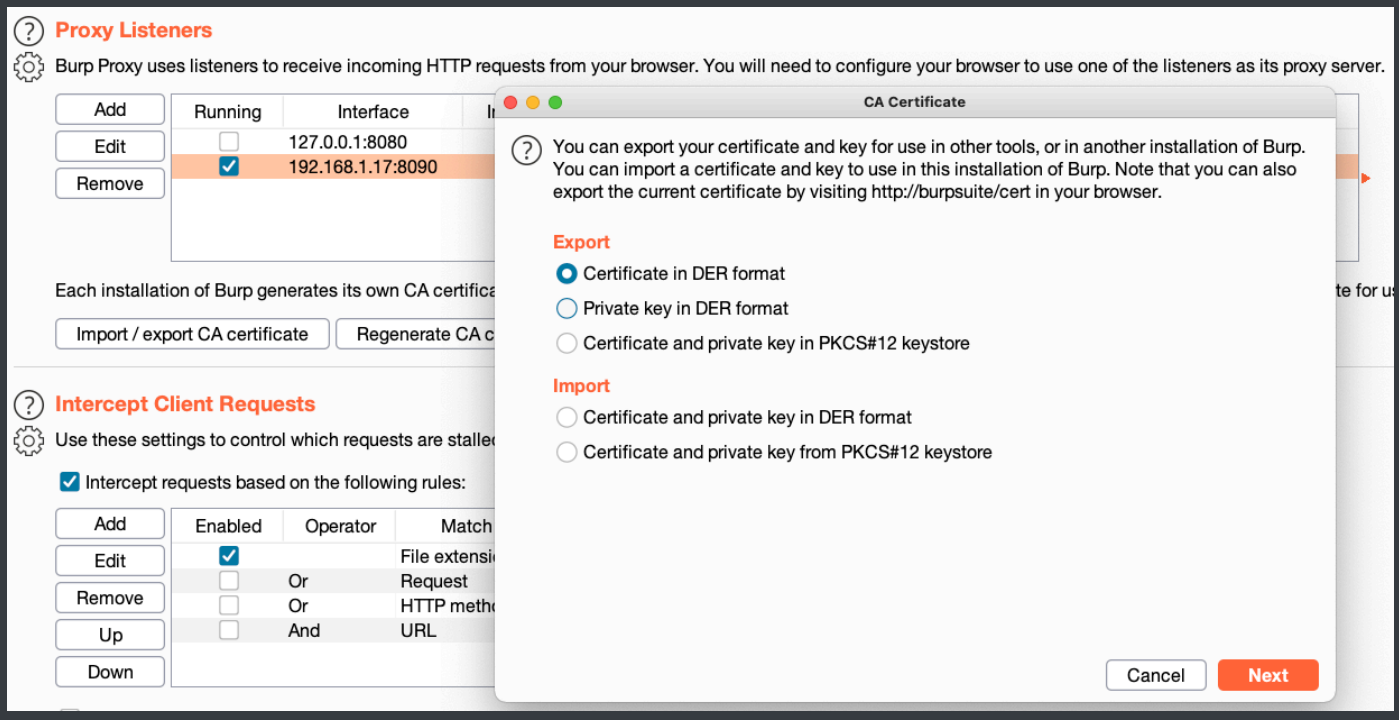
```
adb install Anchored/dist/Anchored.apk
```

```
adb install Anchored.apk
Performing Streamed Install
Success
```

Let's now proceed on issueing a new certificate with Burp, and install it on the user's `Trasted credentials` of the device. On the `Proxy` -> `Options` tab on Burp, we click `Regenerate CA Certificate`.

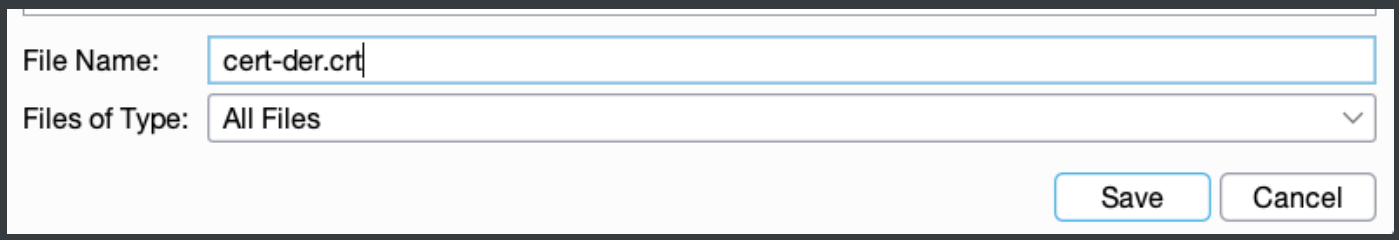


On the confirmation dialog, press `Yes`. Then, we click on `Import / export CA certificate`. On `export` section on the popup window, select `Certificate in DER format` and click `Next`.



Next, click on `select file`.

Name it `cert-der.crt` and save it to `Downloads` directory.



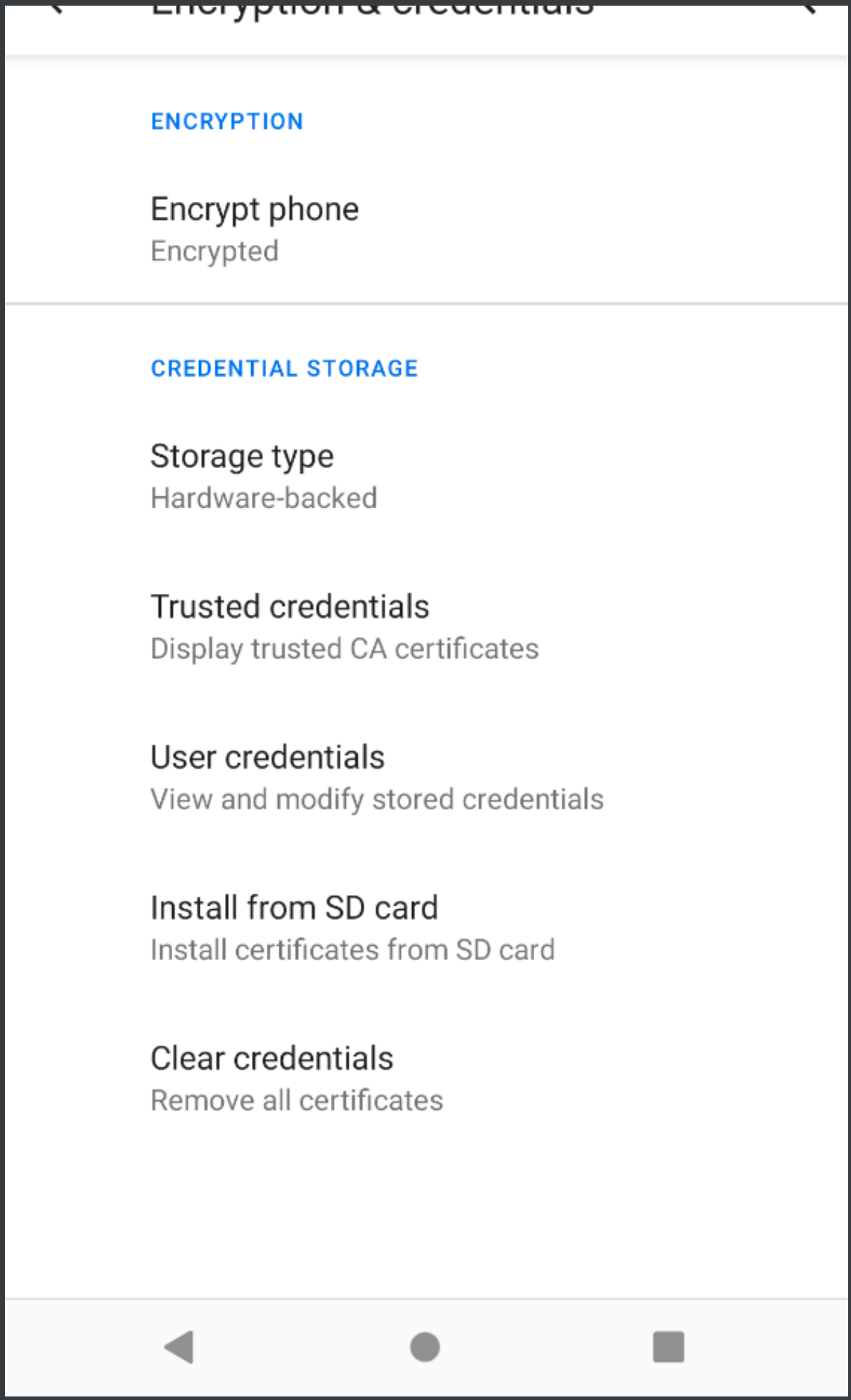
Then click on `Next` once again and then `Close`.

To upload the certificate to the emulator, type the following.

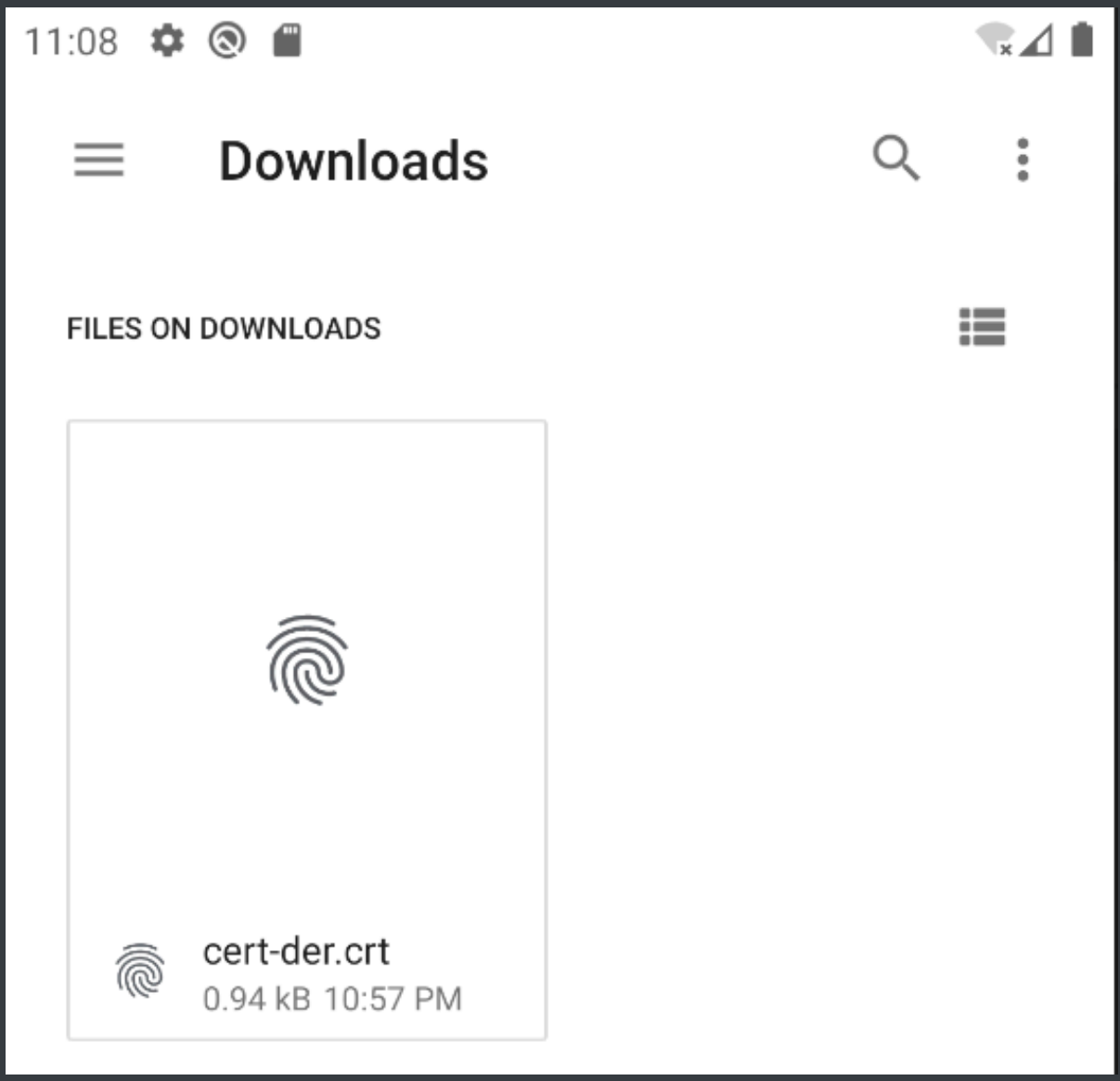
```
adb push cert-der.crt /sdcard/Downloads
```

```
adb push cert-der.crt /sdcard/Download/
cert-der.crt: 1 file pushed, 0 skipped. 0.4 MB/s (939 bytes in 0.002s)
```

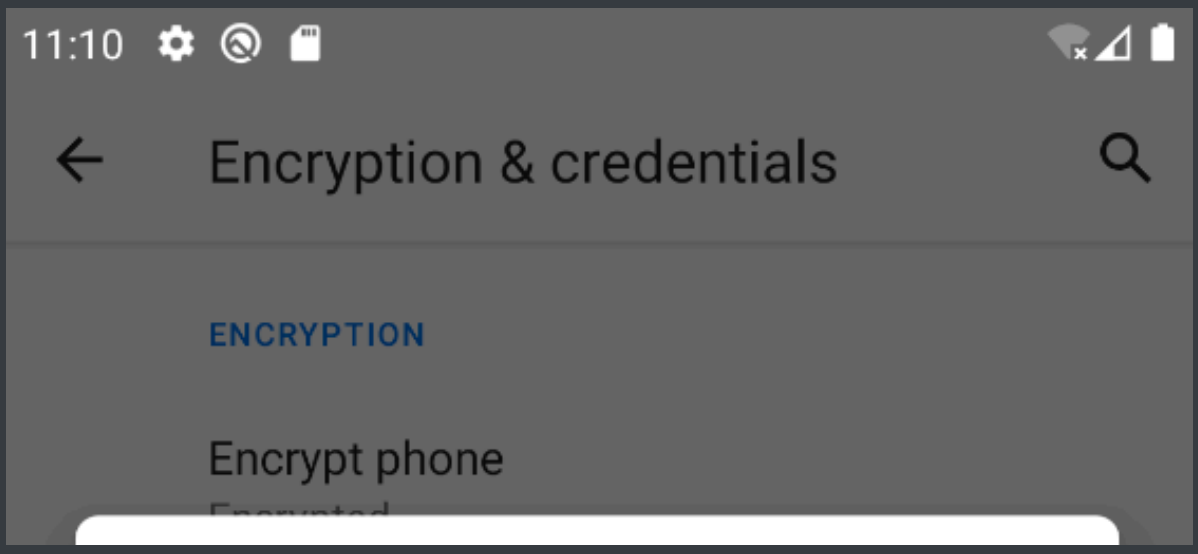
Once the certificate is pushed, we also need to install it to the device. Navigate to `Settings -> Security -> Encryption & credentials`, and tap on the `Install from SD card`.

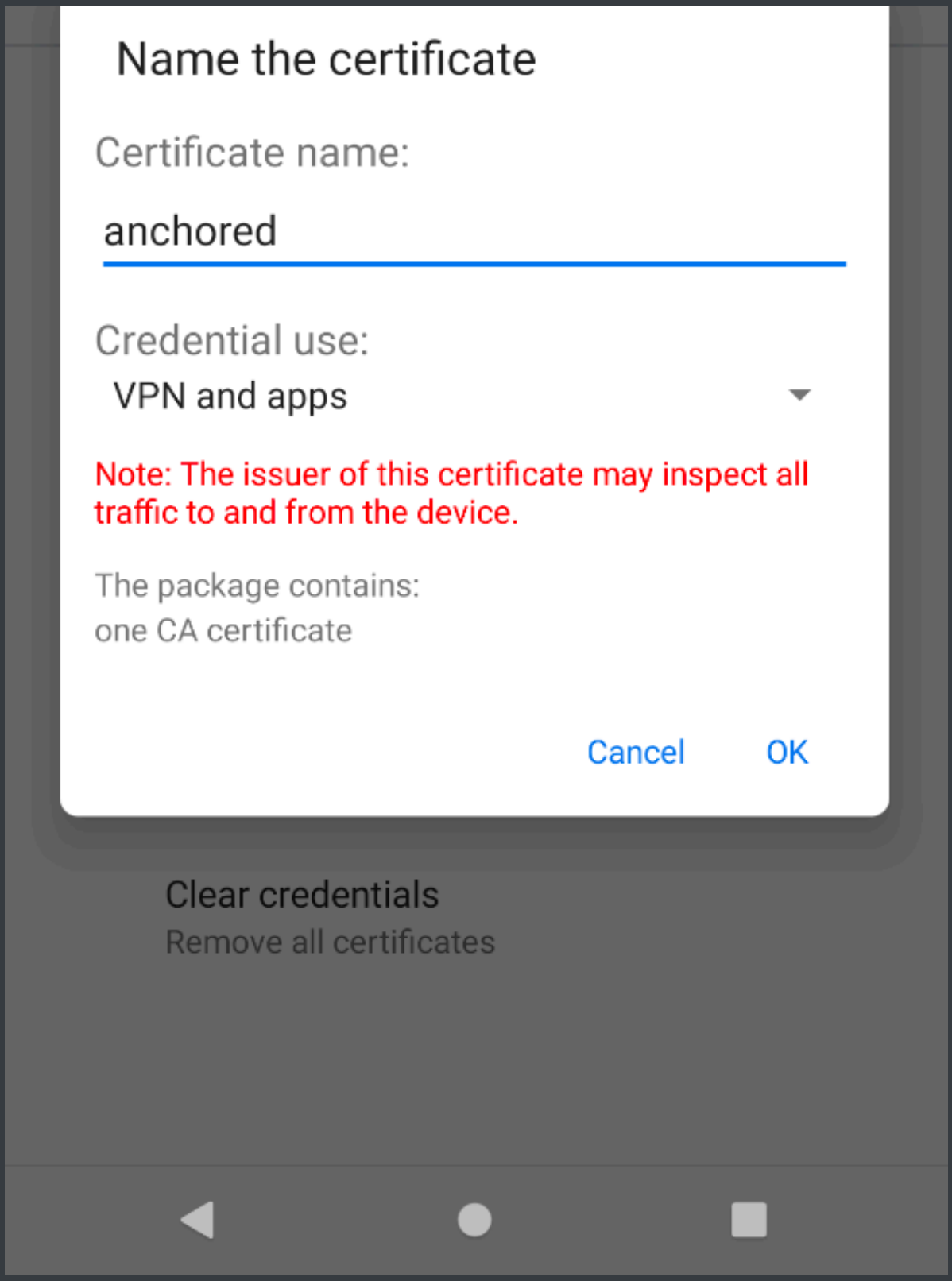

ENCRYPTION
Encrypt phone
Encrypted
CREDENTIAL STORAGE
Storage type
Hardware-backed
Trusted credentials
Display trusted CA certificates
User credentials
View and modify stored credentials
Install from SD card
Install certificates from SD card
Clear credentials
Remove all certificates

Once we tap on it, we navigate to `Downloads` and tap on the certificate that we upload in the previous step.

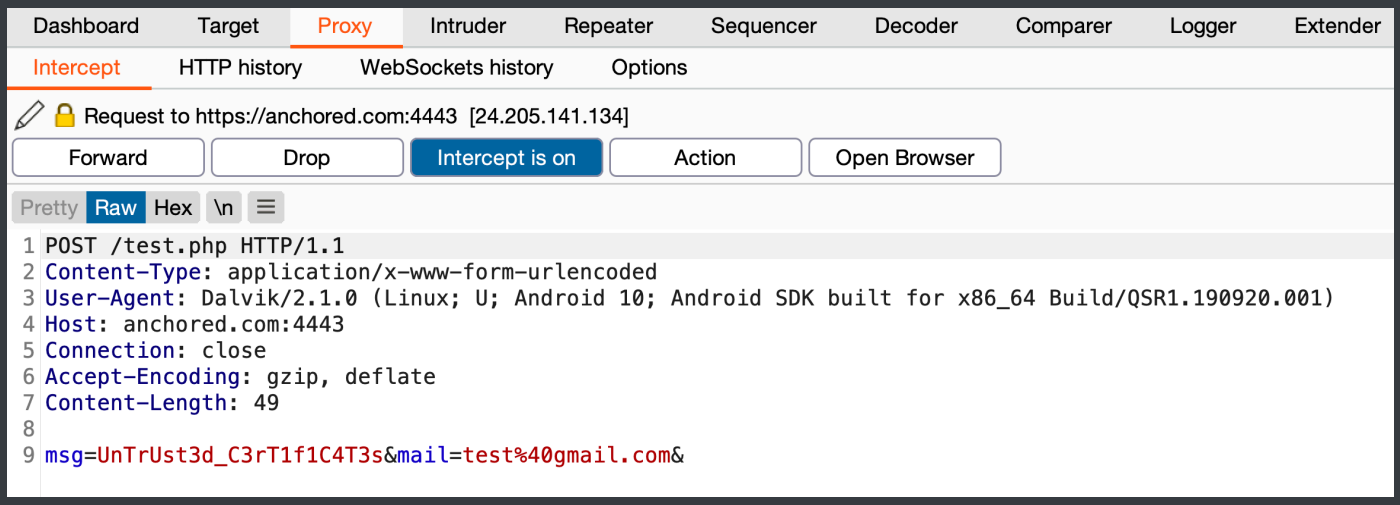


Tap on it, give the certificate a name and tap `OK`.





Let's now run the app and try to intercept the request one more time. Make sure that the `Intercept is on` button on the `Intercept` tab on Burp is toggled on, and tap the `REQUEST ACCESS` button once again on the app. Back on the Burp, we can see that the value `UnTrUst3d_C3rT1f1C4T3s` of the parameter `msg` is captured in plain text.



The flag is `HTB{UnTrUst3d_C3rT1f1C4T3s}`.