

Introduction to Android

Hello World! Application

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04.02.2021

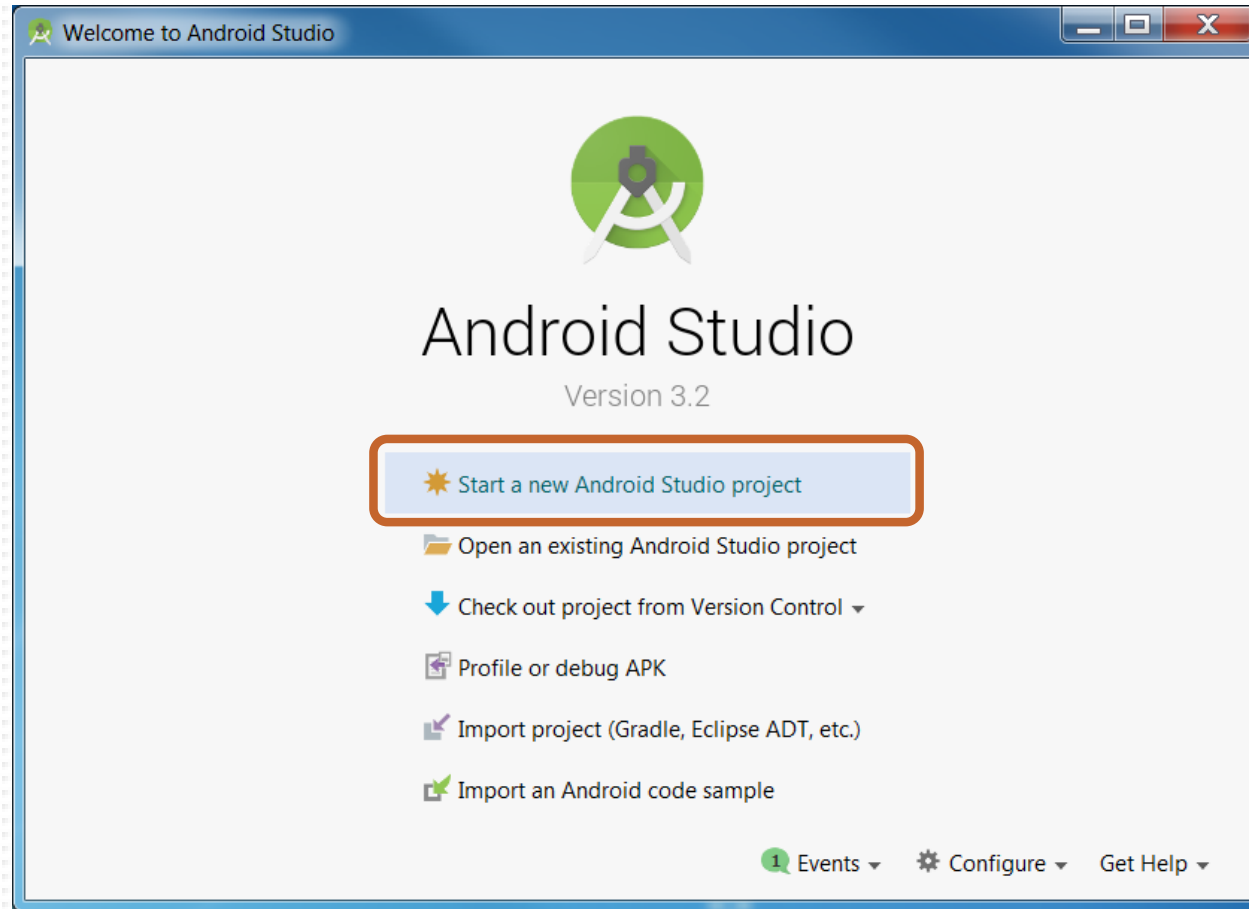
Agenda

- Creating a sample Android TV application
- Adding Activities
- Adding Services
- Adding BroadcastReceivers
- Running the app on the emulator
- Running the app on the device over USB
- Running the app on the device over network
- Profile the app performance
- Debugging the app

Materials

- Application source code can be found on GitHub
 - <https://github.com/CagataySonmez/Android-for-Beginners/tree/master/3-IntroductionToAndroid-HelloWorldApplication>
- Android Studio version 3.2 is used on this training
- Android Studio can be downloaded from the official website
 - <https://developer.android.com/studio/>
- Free courses can be found on Google Developers Training website
 - <https://developers.google.com/training/android/>

Creating Android TV App I



Creating Android TV App II

Create New Project

Create Android Project

Application name
Sample App

Company domain
arcelik.com

Project location
D:\Users\AR430805\AndroidStudioProjects\SampleApp

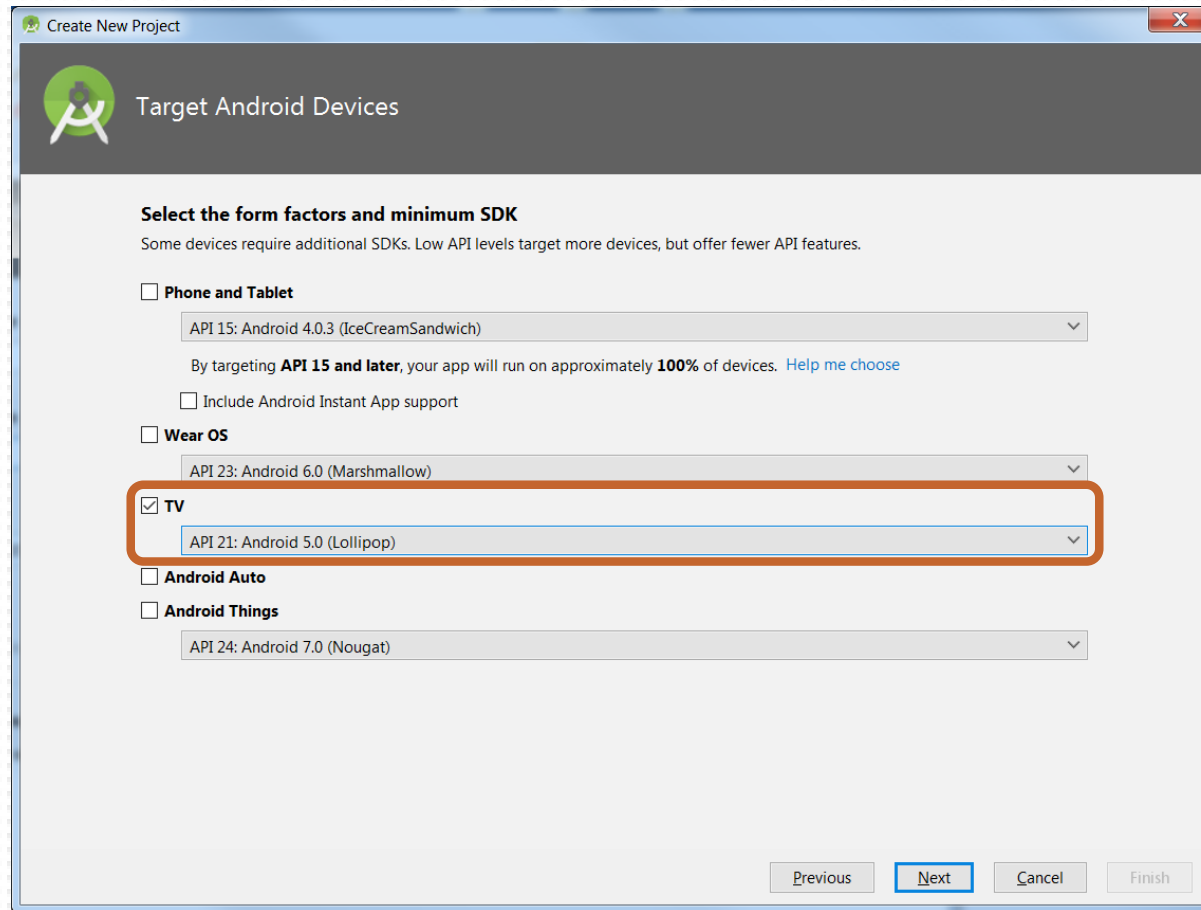
Package name
com.arcelik.sampleapp Edit

☐ Include C++ support


☐ Include Kotlin support

Previous Next Cancel Finish

Creating Android TV App III



Create New Project

 Target Android Devices

Select the form factors and minimum SDK
Some devices require additional SDKs. Low API levels target more devices, but offer fewer API features.

☐ Phone and Tablet
API 15: Android 4.0.3 (IceCreamSandwich) ▼
By targeting **API 15 and later**, your app will run on approximately **100%** of devices. [Help me choose](#)
☐ Include Android Instant App support

☐ Wear OS
API 23: Android 6.0 (Marshmallow) ▼

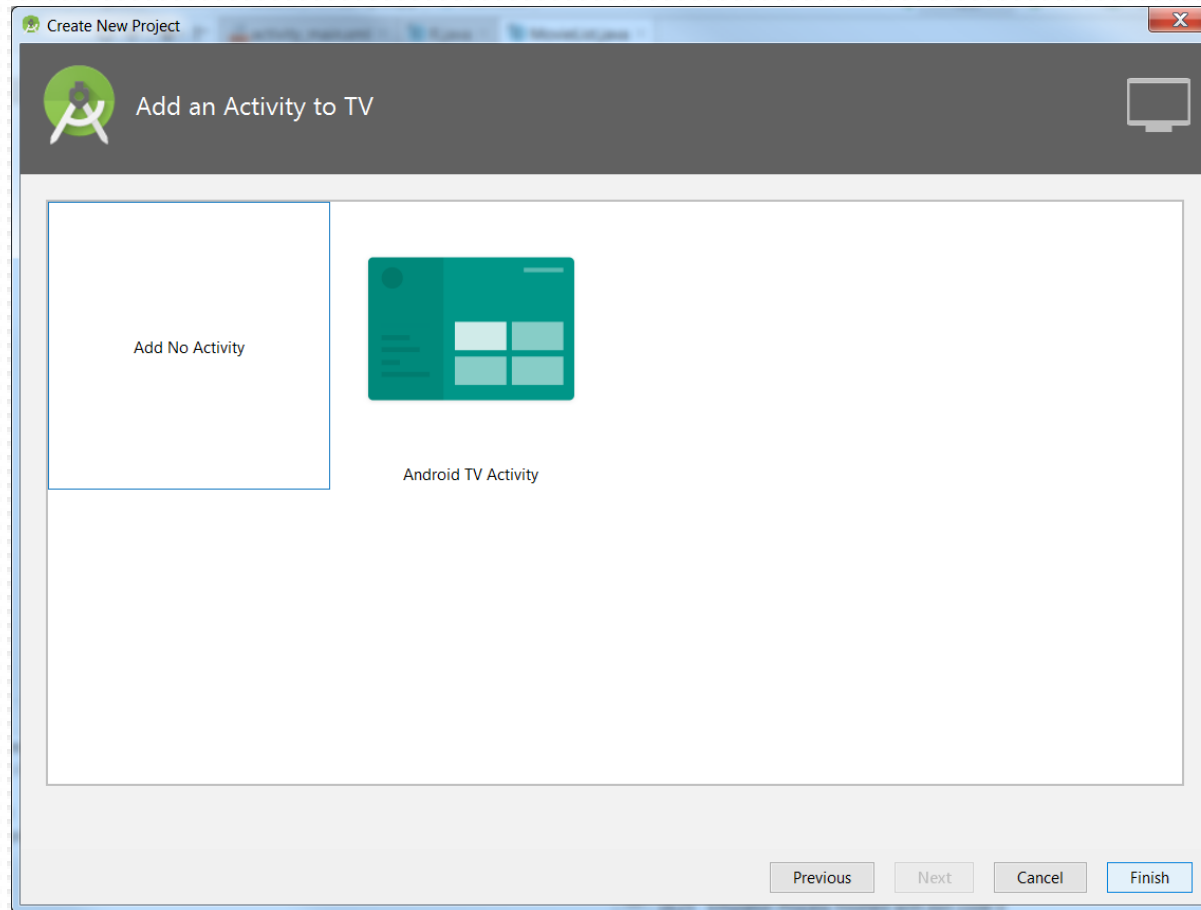
☒ TV
API 21: Android 5.0 (Lollipop) ▼

☐ Android Auto

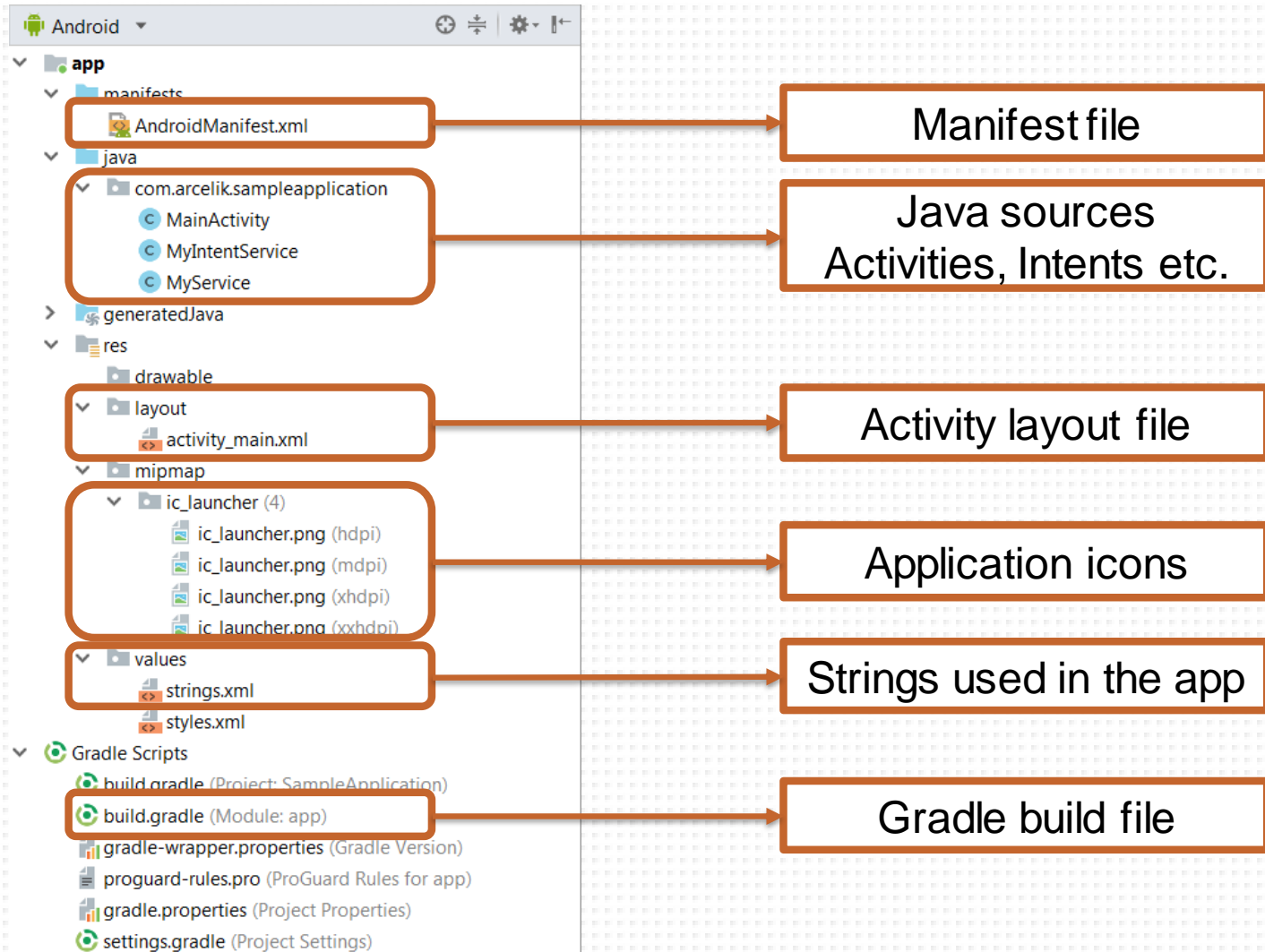
☐ Android Things
API 24: Android 7.0 (Nougat) ▼

Previous Next Cancel Finish

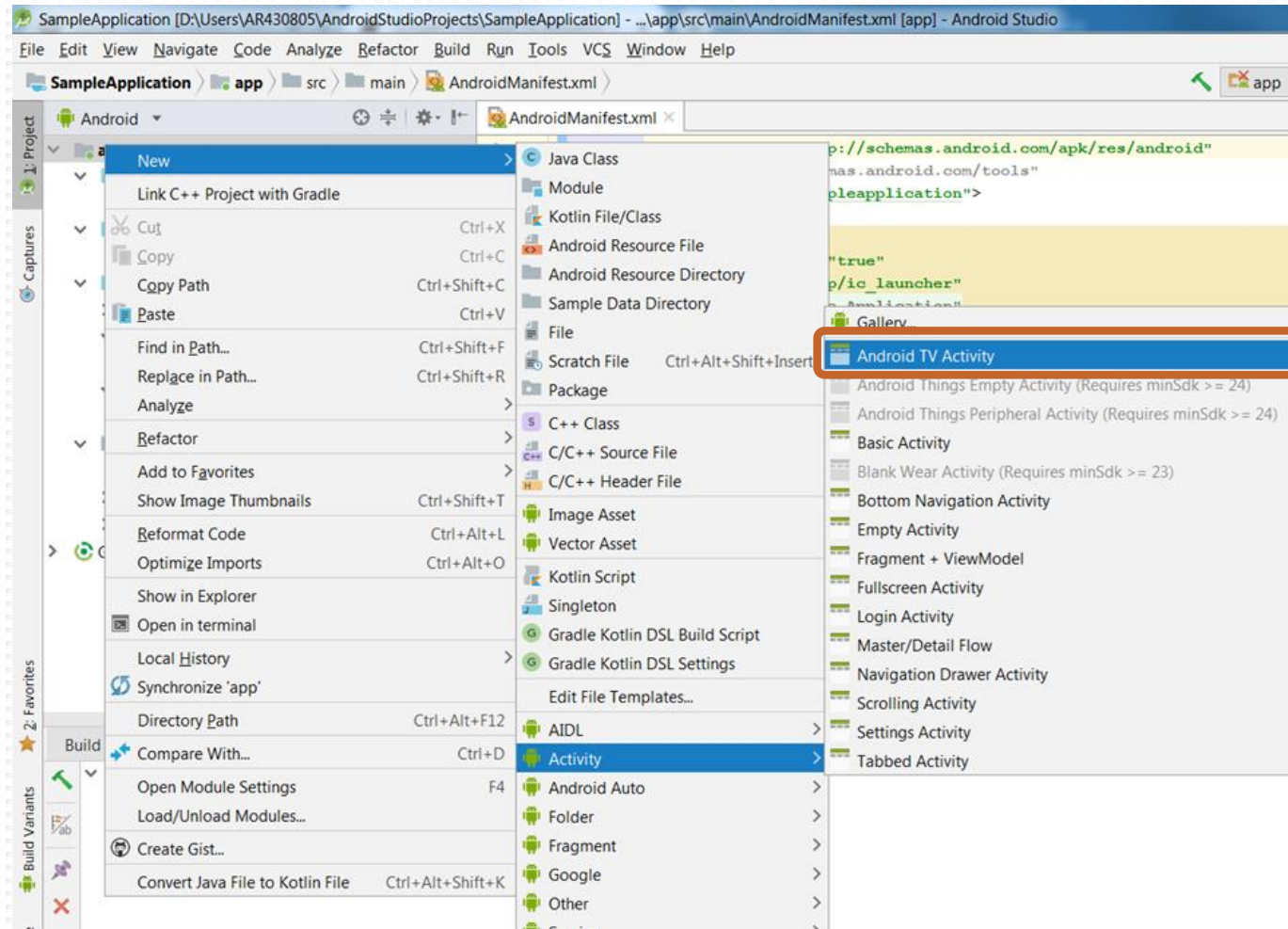
Creating Android TV App IV



Creating Android TV App V





Adding Activity I



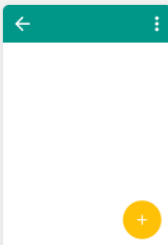
Adding Activity II

New Android Activity

 **Configure Activity**
Android Studio



Creates a new basic activity with an app bar.



Activity Name:

Layout Name:

Title:

☐ Launcher Activity

☐ Use a Fragment

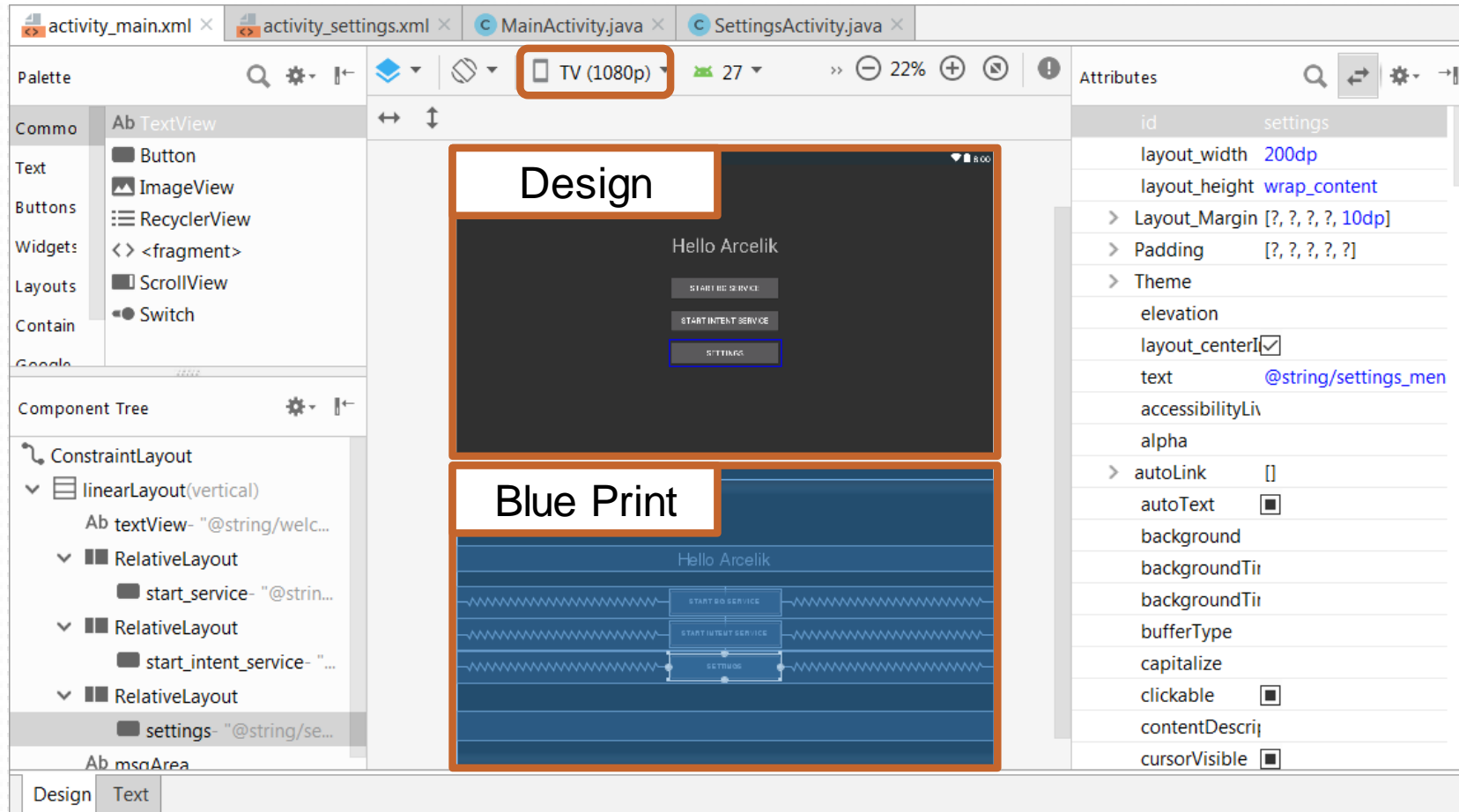
Hierarchical Parent: ...

Package name:

Source Language:

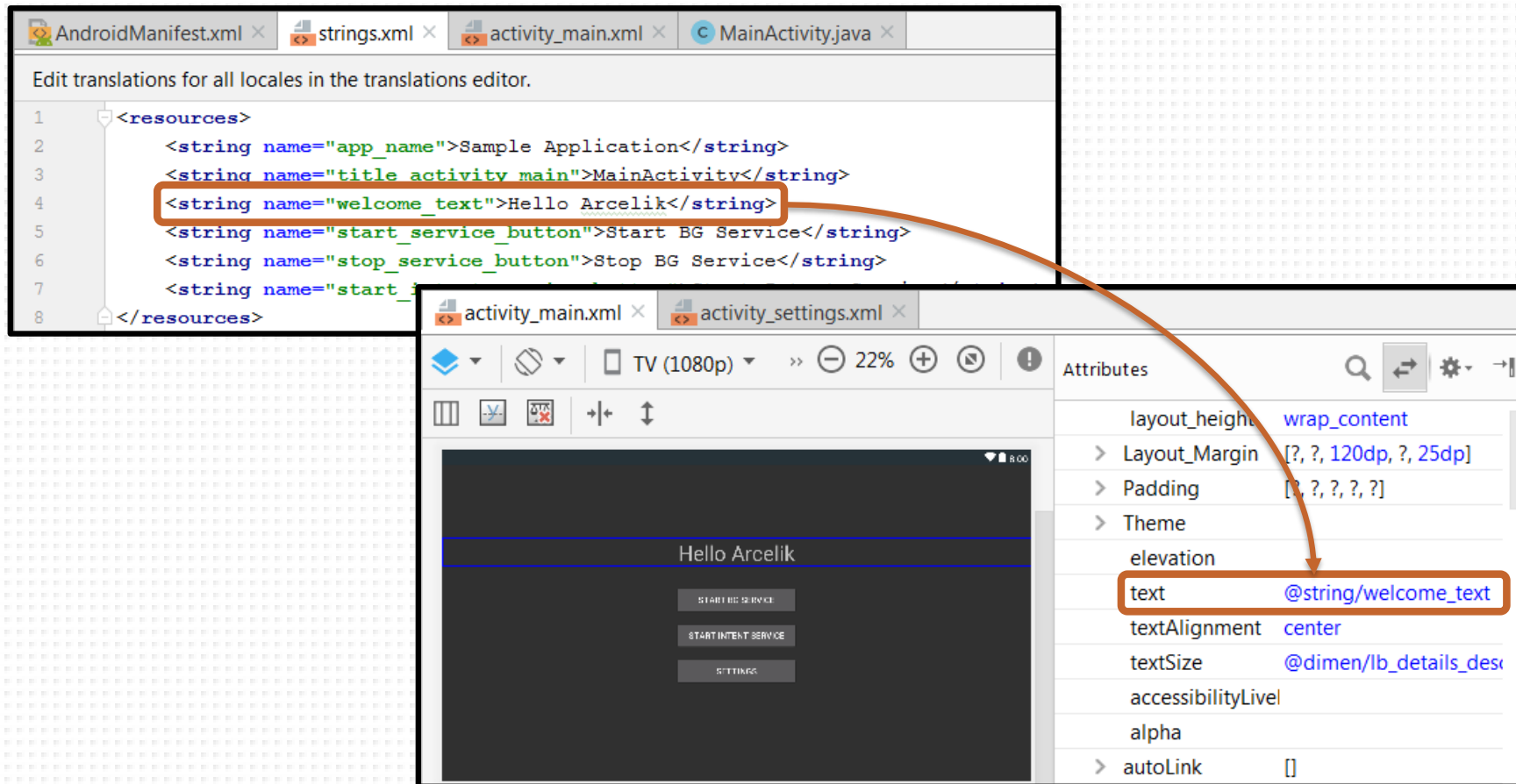
The name of the activity class to create

Activity Layout File



Strings.txt file I

- Do not embed texts to layout file!



Strings.txt file II

- Do not use static texts in your source code!



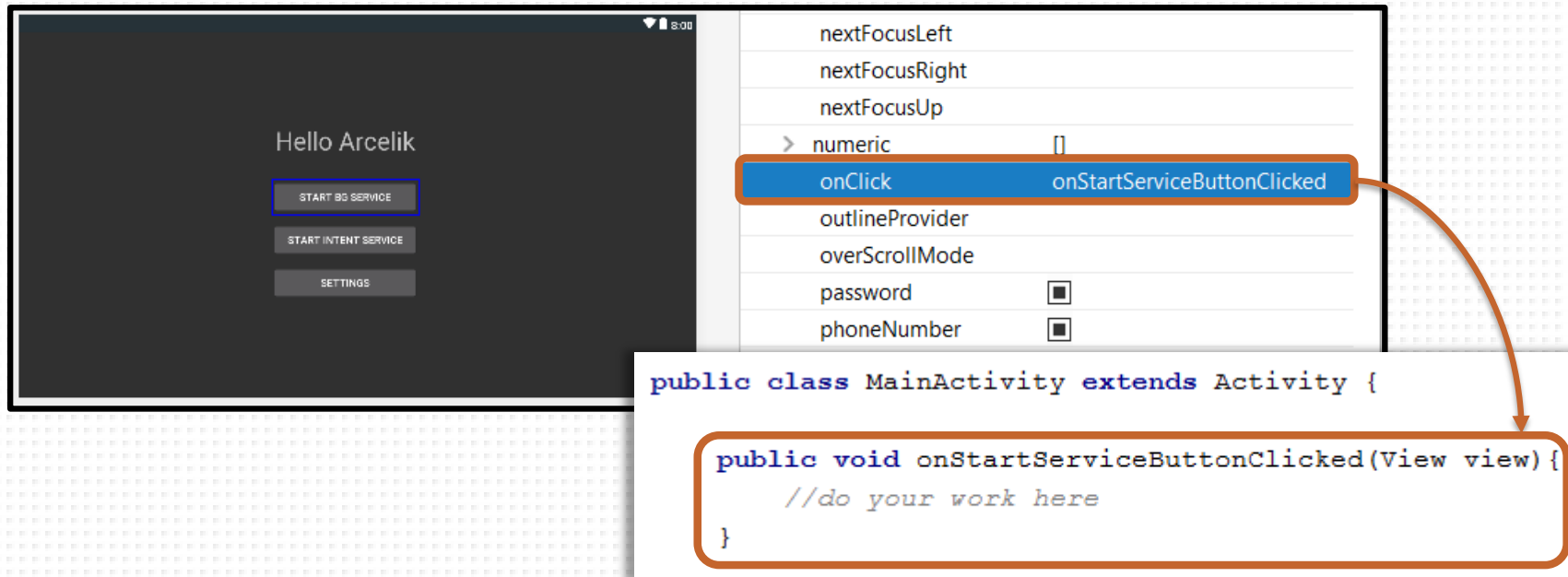
```
if (isMyServiceRunning (MyService.class))  
    ((Button) findViewById(R.id.start_service)).setText("Stop BG Service");
```



```
if (isMyServiceRunning (MyService.class))  
    ((Button) findViewById(R.id.start_service)).setText(R.string.stop_service_button);
```

Handling Click Events of Button I

- There are many options to handle click events of button
- Option 1: Using onClick property in xml layout file
- The callback function's signature cannot be changed!



The image shows a screenshot of an Android application interface on the left and its XML layout on the right. The interface displays "Hello Arcelik" and three buttons: "START BG SERVICE", "START INTENT SERVICE", and "SETTINGS". The "START BG SERVICE" button is highlighted with a blue border. The XML layout on the right shows various properties for the button, with the `onClick` property highlighted in blue and its value `onStartServiceButtonClicked` shown. An orange arrow points from the `onClick` property to a code snippet box below. The code snippet shows the implementation of the `onStartServiceButtonClicked` method in the `MainActivity` class.

```
public class MainActivity extends Activity {  
    public void onStartServiceButtonClicked(View view) {  
        //do your work here  
    }  
}
```

Handling Click Events of Button II

- Option 2: Using an View.OnClickListener via an **anonymous inner class**
- The system executes the code in onClick on the main thread!

```
@Override
protected void onCreate(Bundle savedInstanceState) {
    super.onCreate(savedInstanceState);
    setContentView(R.layout.activity_main);

    // set onclick listener of start_service button
    Button startService = (Button)findViewById(R.id.start_service);
    startService.setOnClickListener(new View.OnClickListener() {
        @Override
        public void onClick(View v) {
            //Do your work here
        }
    });
}
```

Handling Click Events of Button III

- Option 3: Using a View.OnClickListener via an anonymous inner class which can be reusable

```
private View.OnClickListener startServiceOnClickListener = new View.OnClickListener() {  
    @Override  
    public void onClick(View v) {  
        //Do your work here  
    }  
};  
  
@Override  
protected void onCreate(Bundle savedInstanceState) {  
    super.onCreate(savedInstanceState);  
    setContentView(R.layout.activity_main);  
  
    // set onclick listener of start_service button  
    Button startService = (Button)findViewById(R.id.start_service);  
    startService.setOnClickListener(startServiceOnClickListener);  
}
```


Handling Click Events of Button IV

- Option 4: Using your own class by implementing View.OnClickListener Interface

```
class StartServiceButtonClick implements View.OnClickListener {  
    @Override  
    public void onClick(View v) {  
        //Do your work here  
    }  
}  
  
@Override  
protected void onCreate(Bundle savedInstanceState) {  
    super.onCreate(savedInstanceState);  
    setContentView(R.layout.activity_main);  
  
    // set onclick listener of start_service button  
    Button startService = (Button)findViewById(R.id.start_service);  
    startService.setOnClickListener(new StartServiceButtonClick());  
}
```

Starting Another (Settings) Activity

1. Add a button click listener
2. Create an explicit Intent when the button is clicked
3. Start Activity via created Intent

```
// Handle onClickListener of settings button.  
Button settings = (Button)findViewById(R.id.settings);  
settings.setOnClickListener(new View.OnClickListener() {  
    @Override  
    public void onClick(View v) {  
        Intent intent = new Intent( packageContext: MainActivity.this, SettingsActivity.class);  
        startActivity(intent);  
    }  
});
```

Read/Write Application Settings

```
@Override
protected void onCreate(Bundle savedInstanceState) {
    super.onCreate(savedInstanceState);
    setContentView(R.layout.activity_settings);

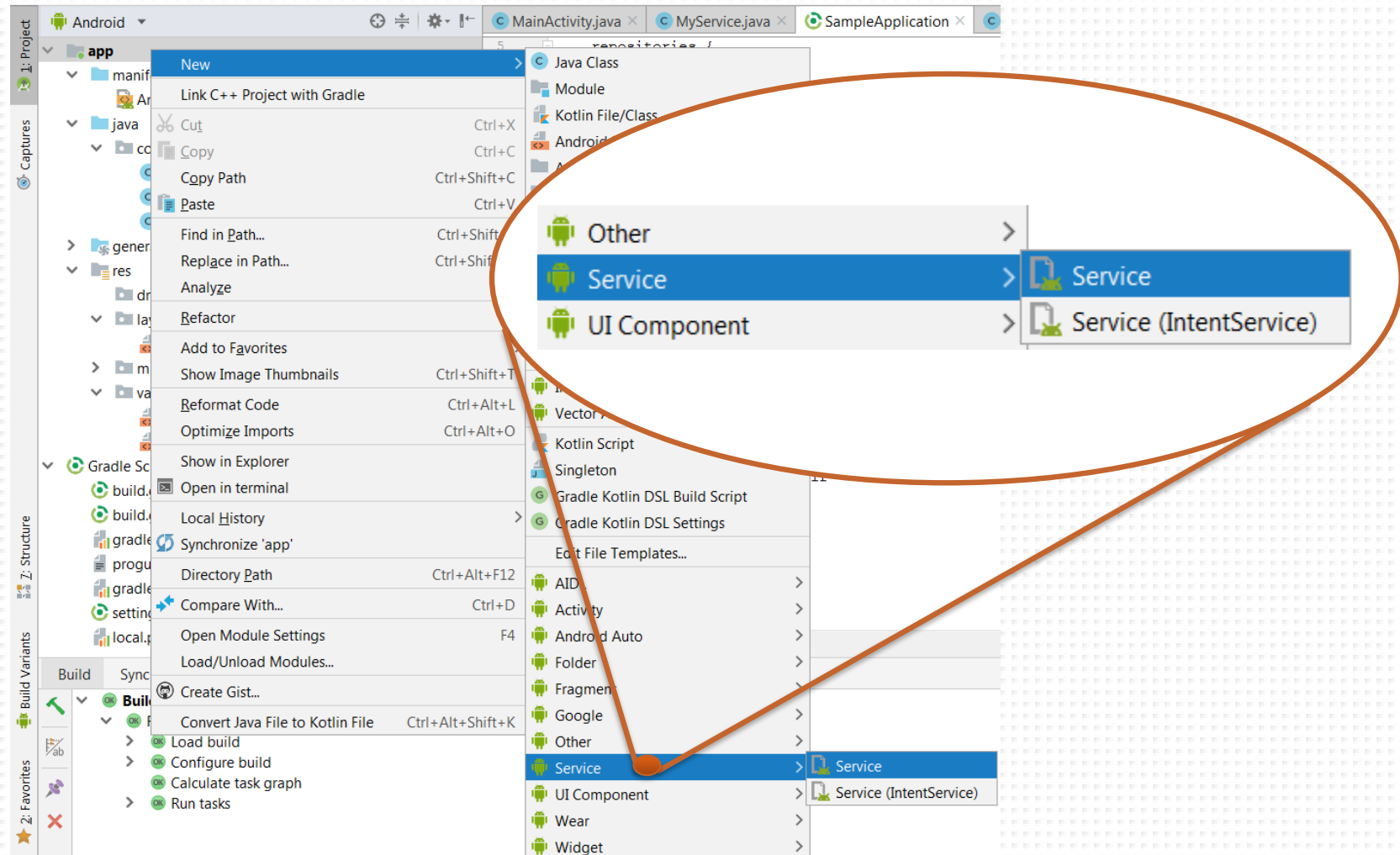
    //get last saved value from preferences
    SharedPreferences sharedPref = getPreferences(Context.MODE_PRIVATE);
    String lastSavedDate = sharedPref.getString(S: "last_saved_date", s1: "unsaved!");

    //Use last saved date

    // Handle onClickListener of save button.
    Button save = (Button)findViewById(R.id.save);
    save.setOnClickListener(new View.OnClickListener() {
        @Override
        public void onClick(View v) {
            String lastSavedDate = getShortDate();
            SharedPreferences sharedPref = getPreferences(Context.MODE_PRIVATE);
            SharedPreferences.Editor editor = sharedPref.edit();
            editor.putString(S: "last_saved_date", lastSavedDate);
            editor.commit();
        }
    });
}
```



Adding Service

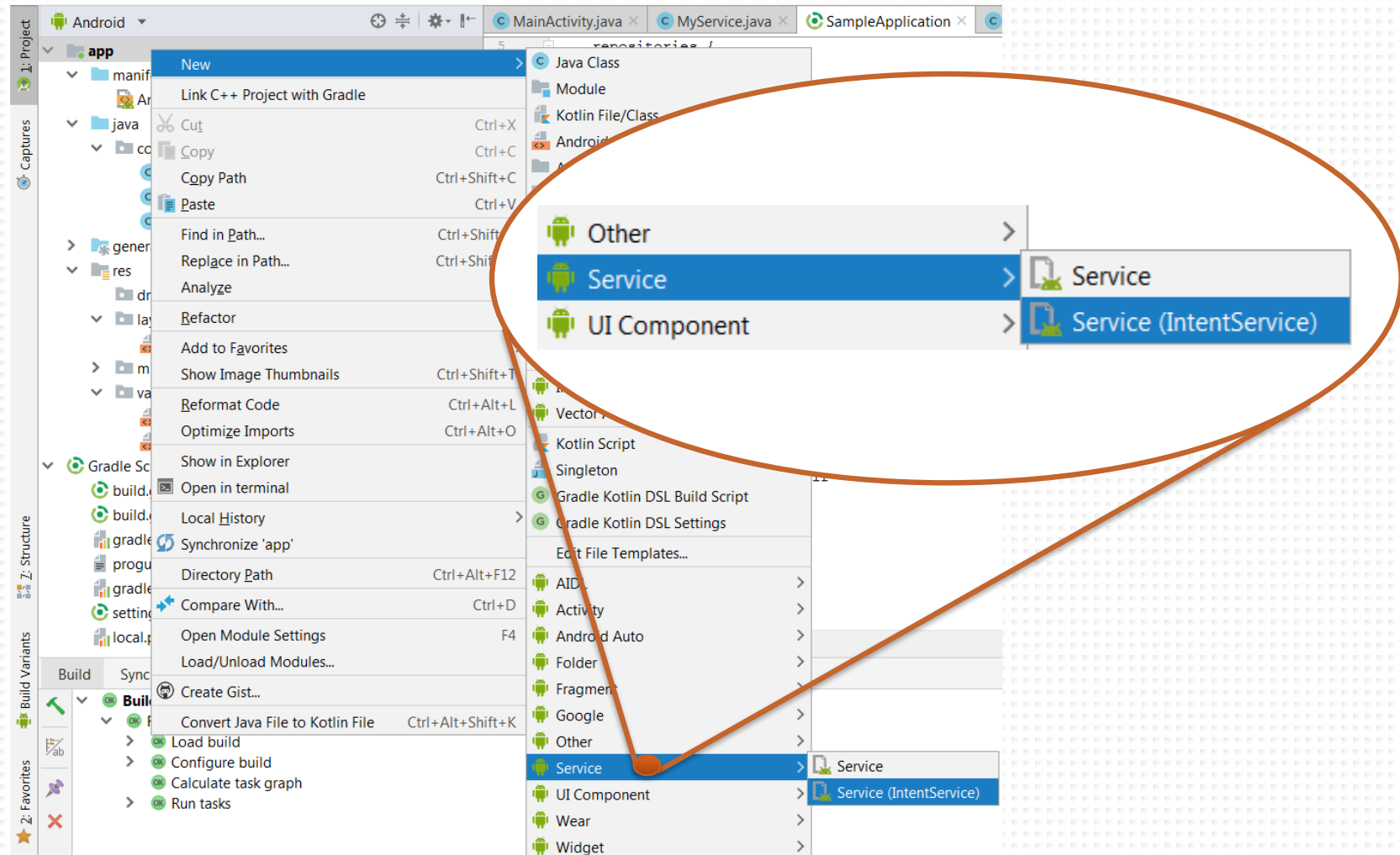


Toggle the Service

1. Add a button click listener
2. Create an explicit Intent when the button is clicked
3. Start or stop the Service via created Intent

```
// Click this button to start service.
Button startService = (Button)findViewById(R.id.start_service);
startService.setOnClickListener((v) → {
    Intent intent = new Intent( packageContext: MainActivity.this, MyService.class);
    if(isMyServiceRunning(MyService.class)) {
        stopService(intent);
        ((Button)findViewById(R.id.start_service)).setText("Start BG Service");
    }
    else {
        startService(intent);
        ((Button)findViewById(R.id.start_service)).setText("Stop BG Service");
    }
});
```

Adding Intent Service

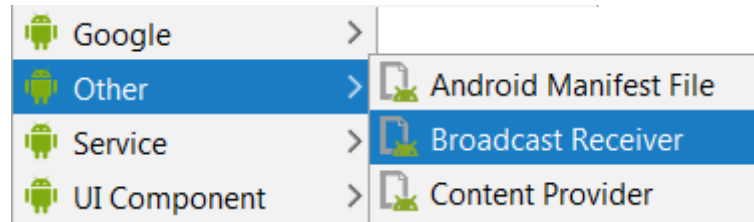
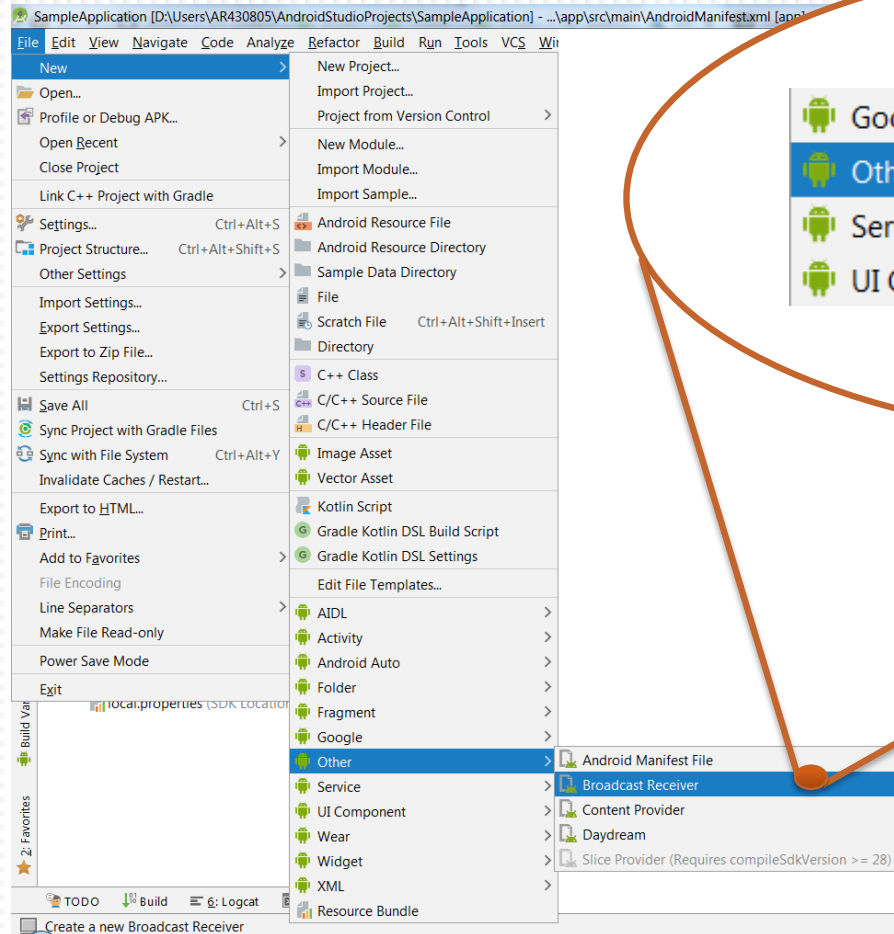


Starting Intent Service

1. Add a button click listener
2. Create an explicit Intent when the button is clicked
3. Set Intent action and extra data
4. Start the Intent Service via created Intent


```
// Click this button to start intent service.  
Button startIntentService = (Button)findViewById(R.id.start_intent_service);  
startIntentService.setOnClickListener(new View.OnClickListener() {  
    @Override  
    public void onClick(View v) {  
        Intent intent = new Intent( packageContext: MainActivity.this, MyIntentService.class);  
        intent.setAction(MyIntentService.ACTION_SEND_NOTIFICATION);  
        intent.putExtra(MyIntentService.NOTIFICATION_METHOD, value: "TOAST");  
        startService(intent);  
    }  
});
```

Adding Broadcast Receiver I



Adding Broadcast Receiver II

New Android Component

 **Configure Component**
Android Studio

Creates a new broadcast receiver component and adds it to your Android manifest.

Class Name:

☒ Exported

☒ Enabled

Source Language:

Previous Next Cancel **Finish**

Sending Broadcast

1. Declare related permission in manifest file

```
<permission  
    android:name="com.arcelik.sampleapplication.permission.NOTIFICATION"  
    android:protectionLevel="dangerous">  
</permission>  
  
<uses-permission android:name="com.arcelik.sampleapplication.permission.NOTIFICATION" />
```

2. Send broadcast message in your application

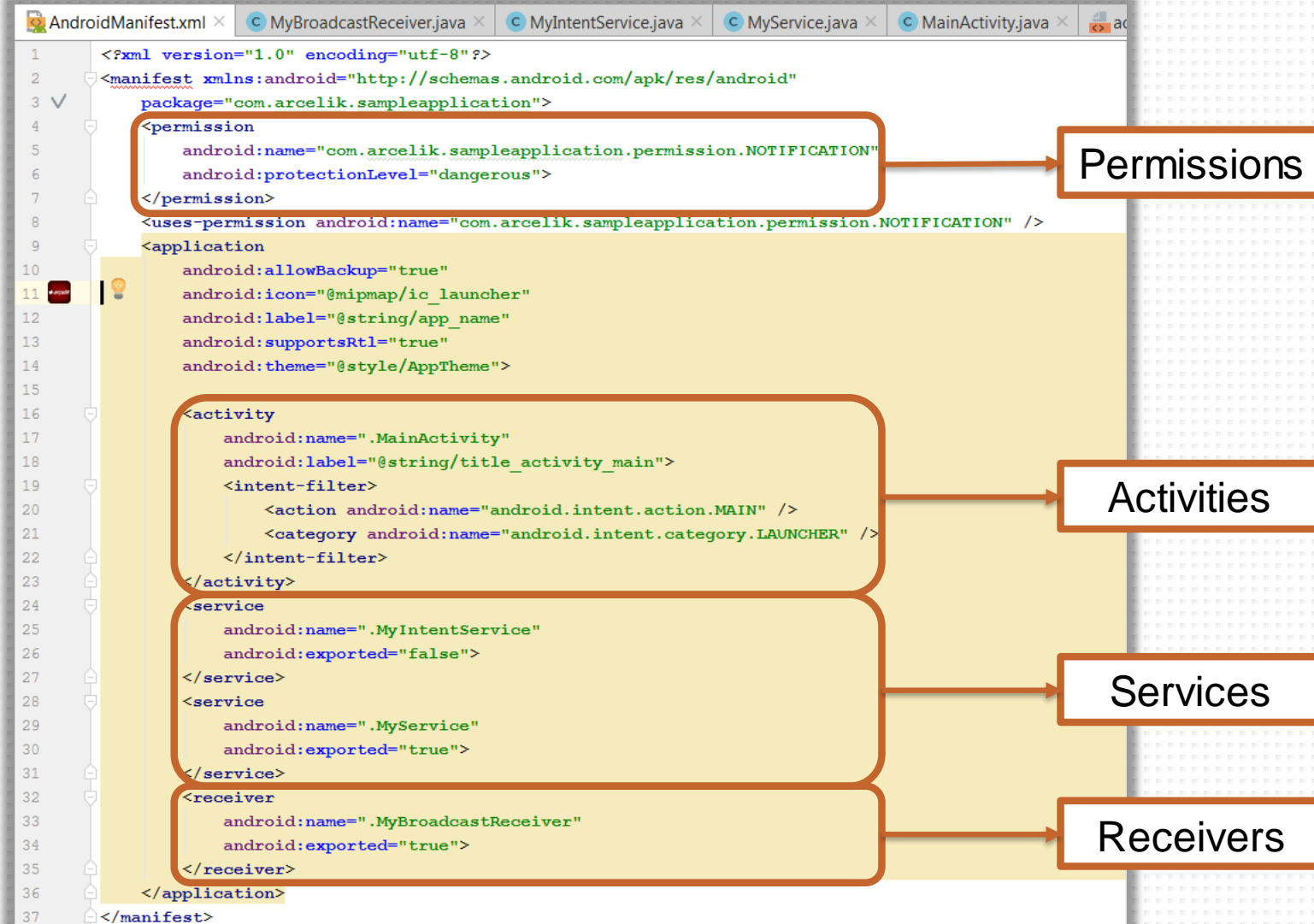
```
//Send broadcast  
Log.d(TAG_SERVICE, msg: "Sending message to activity: " + notification);  
final Intent intent = new Intent(BROADCAST_INTENT);  
intent.putExtra(name: "msg", value: dateAsStr + ":" + notification);  
sendBroadcast(intent, BROADCAST_PERMISSION);
```

Receiving Broadcast

1. Create an IntentFilter to catch proper broadcast event
2. Create BroadcastReceiver and override onReceive method
3. Do your job with Intent provided by the receiver

```
public class MainActivity extends Activity {  
  
    //Use broadcast receiver to get broadcast messages  
    final IntentFilter myFilter = new IntentFilter(MyService.BROADCAST_INTENT);  
    private MyBroadcastReceiver mReceiver = new MyBroadcastReceiver() {  
        @Override  
        public void onReceive(Context context, Intent intent) {  
            final TextView responseFromService = (TextView)findViewById(R.id.msgArea);  
            responseFromService.setText(intent.getCharSequenceExtra( name: "msg"));  
        }  
    };  
}
```

Manifest File



Adjust App for Android TV Platforms

```
<?xml version="1.0" encoding="utf-8"?>
<manifest xmlns:android="http://schemas.android.com/apk/res/android"
    package="com.arcelik.sampleapplication">

    <uses-feature android:name="android.software.leanback" android:required="true" />
    <uses-feature android:name="android.hardware.touchscreen" android:required="false" />

    <permission
        android:name="com.arcelik.sampleapplication.permission.NOTIFICATION"
        android:protectionLevel="normal">
    </permission>

    <uses-permission android:name="com.arcelik.sampleapplication.permission.NOTIFICATION" />

    <application
        android:allowBackup="true"
        android:icon="@mipmap/ic_launcher"
        android:banner="@drawable/ic_banner"
        android:label="@string/app_name"
        android:supportsRtl="true"
        android:theme="@style/AppTheme">
        <activity
            android:name=".MainActivity"
            android:label="@string/title_activity_main">
            <intent-filter>
                <action android:name="android.intent.action.MAIN" />
                <category android:name="android.intent.category.LAUNCHER" />
                <category android:name="android.intent.category.LEANBACK_LAUNCHER" />
            </intent-filter>
        </activity>
    </application>
</manifest>
```

Make it compatible with TVs

Disable mobile devices

320x180 px banner icon

To launch app from home screen

Gradle Build File

build.gradle (:app) X

You can use the Project Structure dialog to view and edit your project configuration

```
1  apply plugin: 'com.android.application'
2
3  android {
4      compileSdkVersion 27
5      defaultConfig {
6          applicationId "com.arcelik.sampleapplication"
7          minSdkVersion 21
8          targetSdkVersion 27
9          versionCode 1
10         versionName "1.0"
11     }
12     buildTypes {
13         release {
14             minifyEnabled false
15             proguardFiles getDefaultProguardFile('proguard-android.txt'), 'proguard-rules.pro'
16         }
17     }
18 }
19
20 dependencies {
21     implementation fileTree(dir: 'libs', include: ['*.jar'])
22     implementation 'com.android.support:leanback-v17:27.1.1'
23     implementation 'com.android.support.constraint:constraint-layout:1.1.3'
24 }
```

App Config

Build Types

Local Libs

Remote Libs

Configuring Build Types

```
android {  
    defaultConfig {  
        manifestPlaceholders = [hostName:"www.example.com"]  
        ...  
    }  
    buildTypes {  
        release {  
            minifyEnabled true  
            proguardFiles getDefaultProguardFile('proguard-android.txt'), 'proguard-rules.pro'  
        }  
  
        debug {  
            applicationIdSuffix ".debug"  
            debuggable true  
        }  
  
        /**  
        * The `initWith` property allows you to copy configurations from other build types,  
        * then configure only the settings you want to change. This one copies the debug build  
        * type, and then changes the manifest placeholder and application ID.  
        */  
        staging {  
            initWith debug  
            manifestPlaceholders = [hostName:"internal.example.com"]  
            applicationIdSuffix ".debugStaging"  
        }  
    }  
}
```

Configuring Build Variants

- Build variants are the result of Gradle using a specific set of rules to combine settings, code, and resources configured in your build types and product flavors.
- You can create and configure build types in the module-level **build.gradle** file inside the android block.
- When you make changes to a build configuration file, Android Studio requires that you sync your project with the new configuration.
- You can change the build variant to whichever one you want to build and run, just go to **Build > Select Build Variant** and select one from the drop-down menu.

Configuring Product Flavors

```
android {  
    ...  
    defaultConfig {...}  
    buildTypes {  
        debug{...}  
        release{...}  
    }  
    // Specifies one flavor dimension.  
    flavorDimensions "version"  
    productFlavors {  
        demo {  
            // Assigns this product flavor to the "version" flavor dimension.  
            // If you are using only one dimension, this property is optional,  
            // and the plugin automatically assigns all the module's flavors to  
            // that dimension.  
            dimension "version"  
            applicationIdSuffix ".demo"  
            versionNameSuffix "-demo"  
        }  
        full {  
            dimension "version"  
            applicationIdSuffix ".full"  
            versionNameSuffix "-full"  
        }  
    }  
}
```

build.gradle File from Real Application

```
app x
1  apply plugin: 'com.android.application'
2
3  android {
4      compileSdkVersion 27
5      defaultConfig {
6          applicationId "com.arcelik.html5testapp"
7          minSdkVersion 22
8          targetSdkVersion 27
9          versionCode 1
10         versionName "1.0"
11         //common app settings
12         resValue "bool", "usesCeHtml", "false"
13         resValue "bool", "overrideKeyCodes", "true"
14         resValue "bool", "overrideUserAgent", "true"
15         resValue "bool", "enableCors", "false"
16         resValue "bool", "disableBack", "true"
17         resValue "integer", "timeout", "30000"
18     }
19     buildTypes {
20         release {
21             minifyEnabled false
22             proguardFiles getDefaultProguardFile('proguard-android.txt'), 'proguard-rules.pro'
23         }
24     }
25
26     // Specifies one flavor dimension.
27     flavorDimensions "html5_app"
```

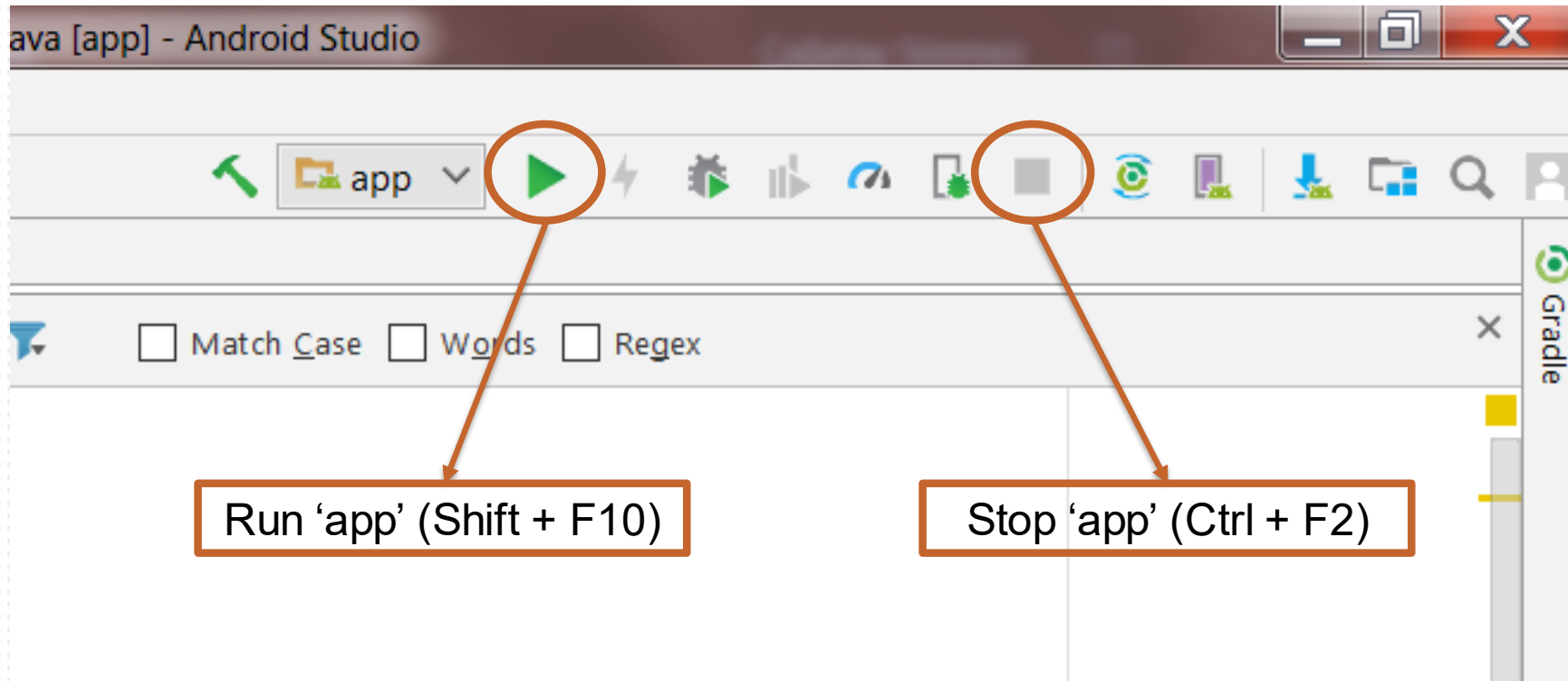
build.gradle File from Real Application

cont.

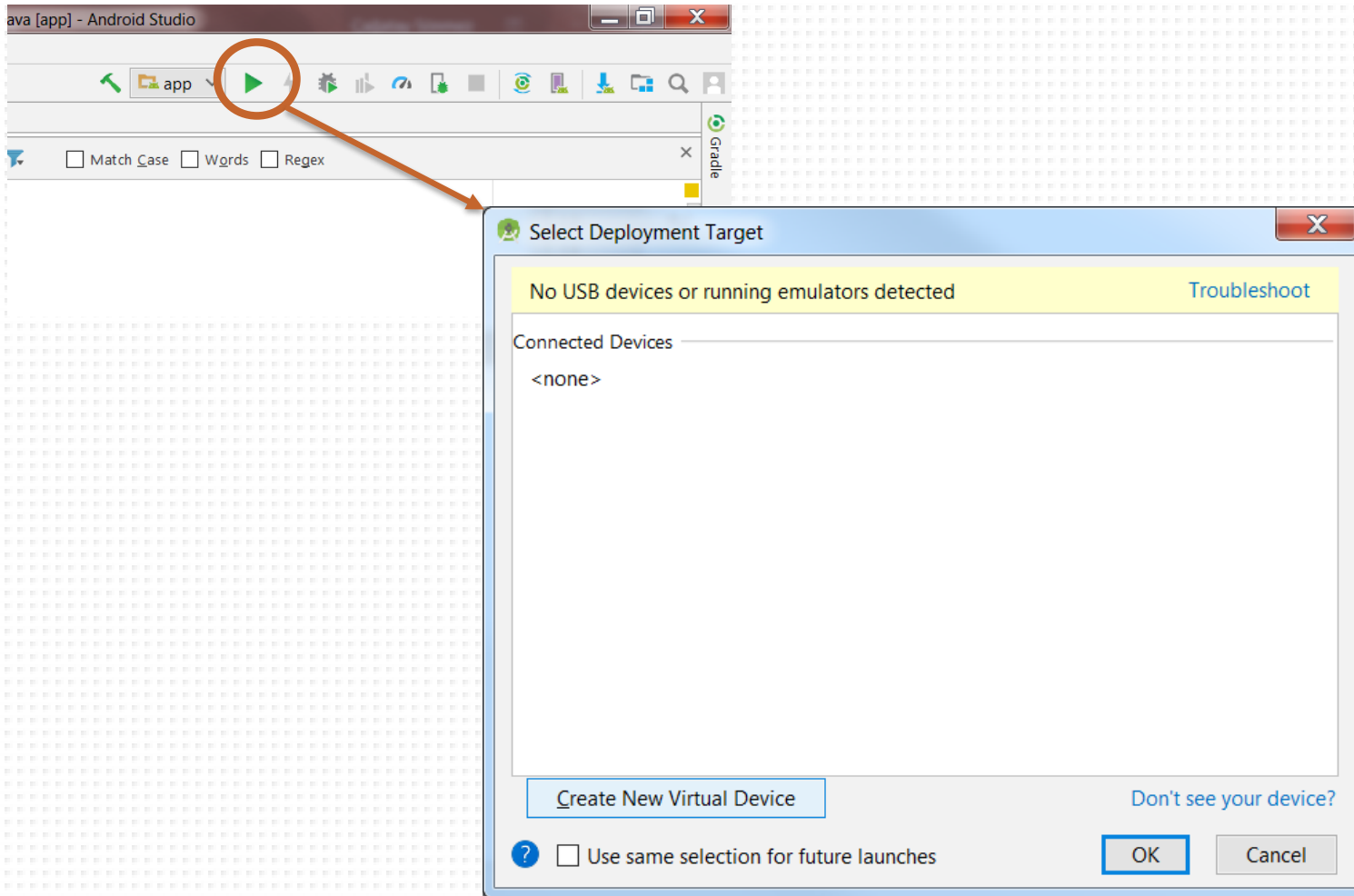
```
app x
26 // Specifies one flavor dimension.
27 flavorDimensions "html5_app"
28 productFlavors {
29     demo {
30         dimension "html5_app"
31         applicationId "com.example.a10433435.i0r128"
32         resValue "string", "app_name", "demo"
33         manifestPlaceholders = [
34             appIcon: "@drawable/demo"
35         ]
36         resValue "string", "app_url", "file:///android_asset/portal/portal.html"
37         resValue "bool", "usesArSmartTV", "true"
38     }
39     trttv {
40         dimension "html5_app"
41         applicationId "com.arcelik.trttv"
42         resValue "string", "app_name", "TRT TV"
43         manifestPlaceholders = [
44             appIcon: "@drawable/trt"
45         ]
46         resValue "string", "app_url", "http://smapp.trt.tv/TvApp/arcelik"
47         resValue "bool", "usesArSmartTV", "false"
48     }
49     puhutv {
50         dimension "html5_app"
51         applicationId "com.arcelik.puhutv"
52         resValue "string", "app name", "puhutv"
```

Running & Debugging Android Application

Running an Android Application I

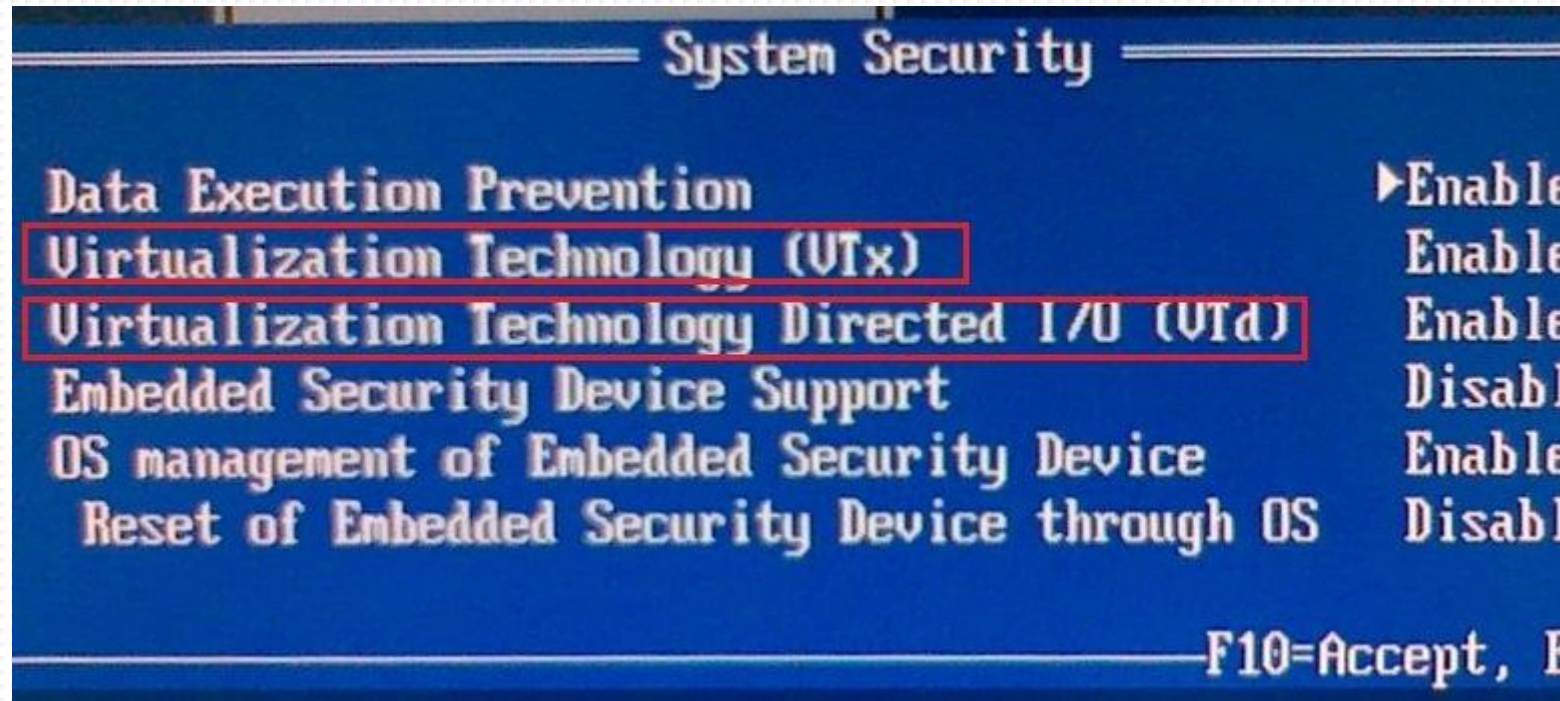


Running an Android Application II

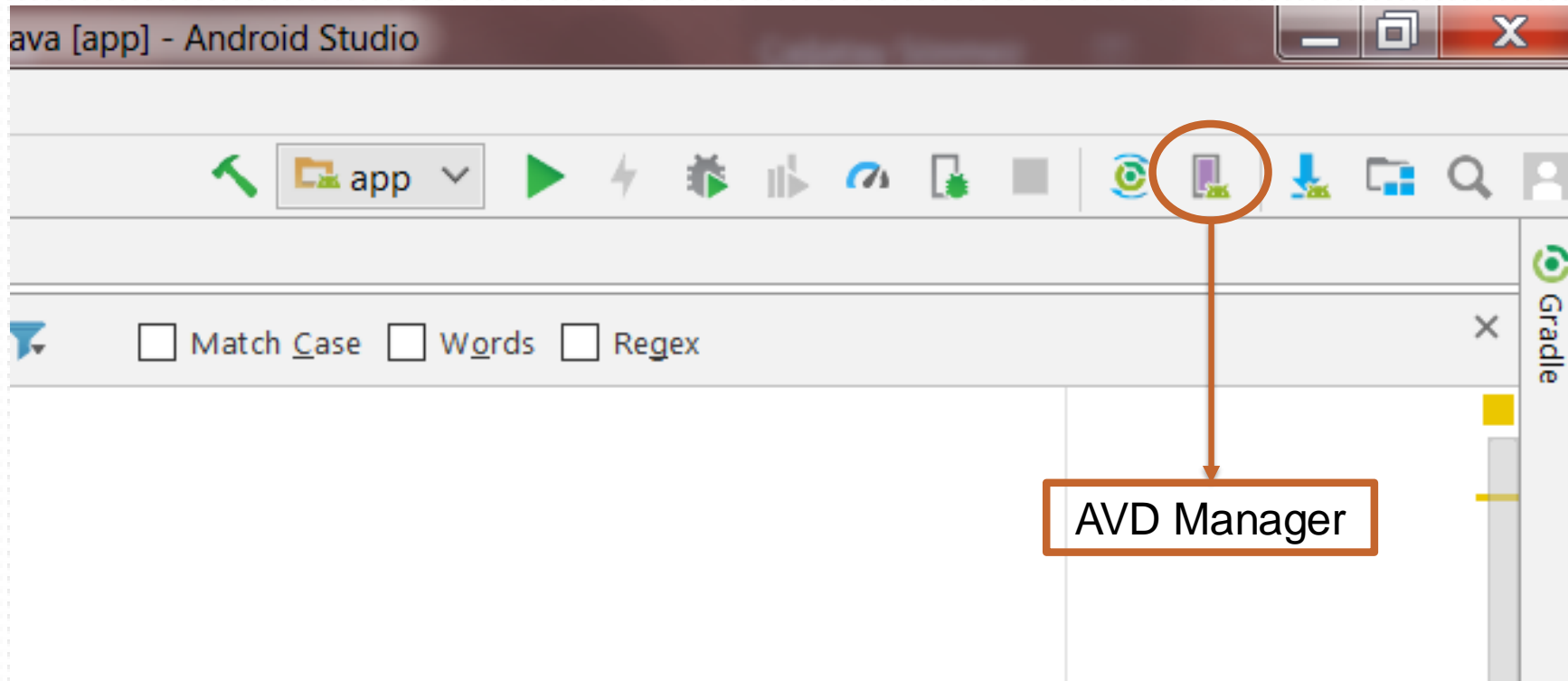


Running App on Emulator

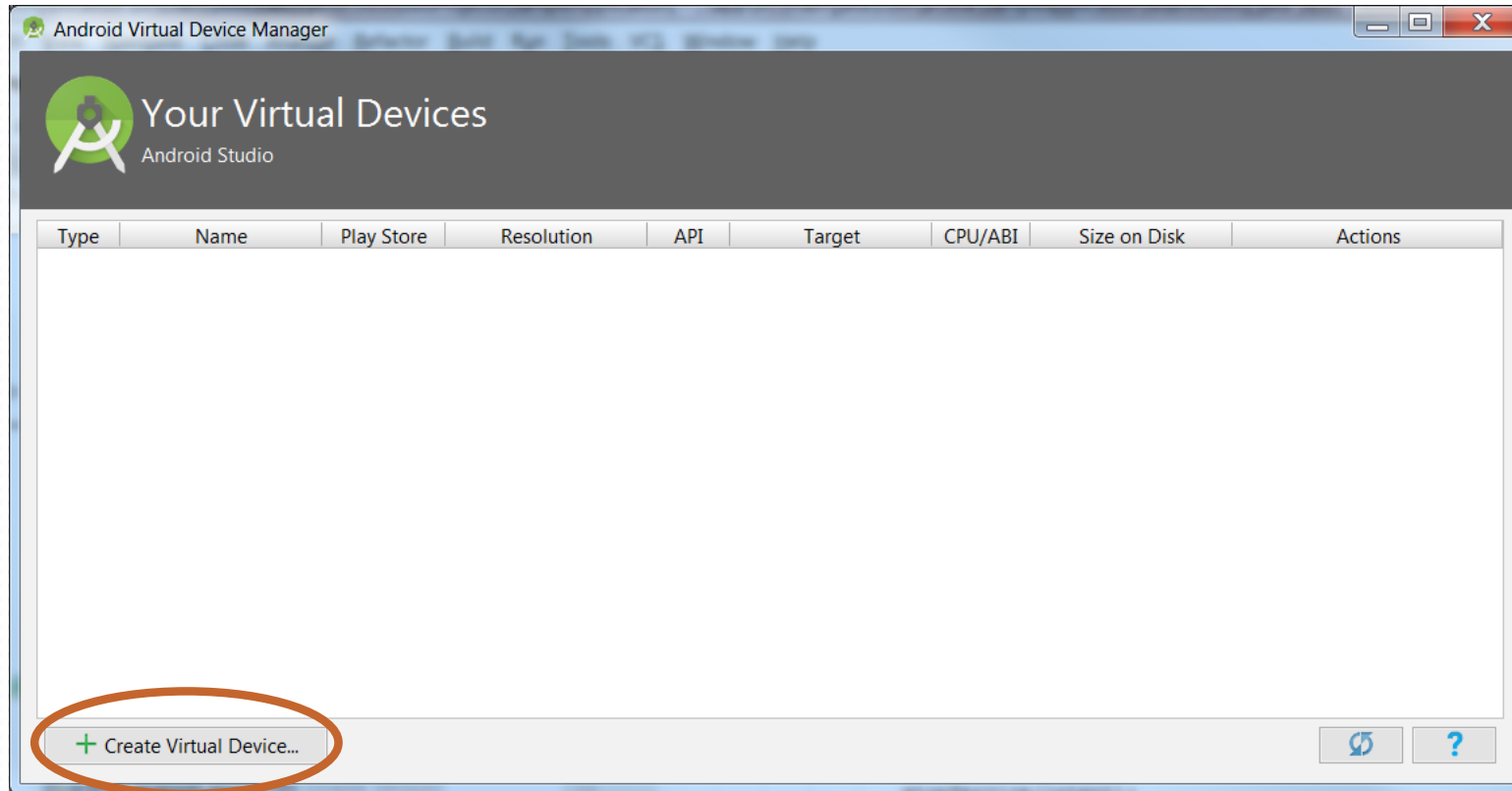
- To use emulator, enable Intel Virtualization Technology or AMD-V depending on the brand of the processor



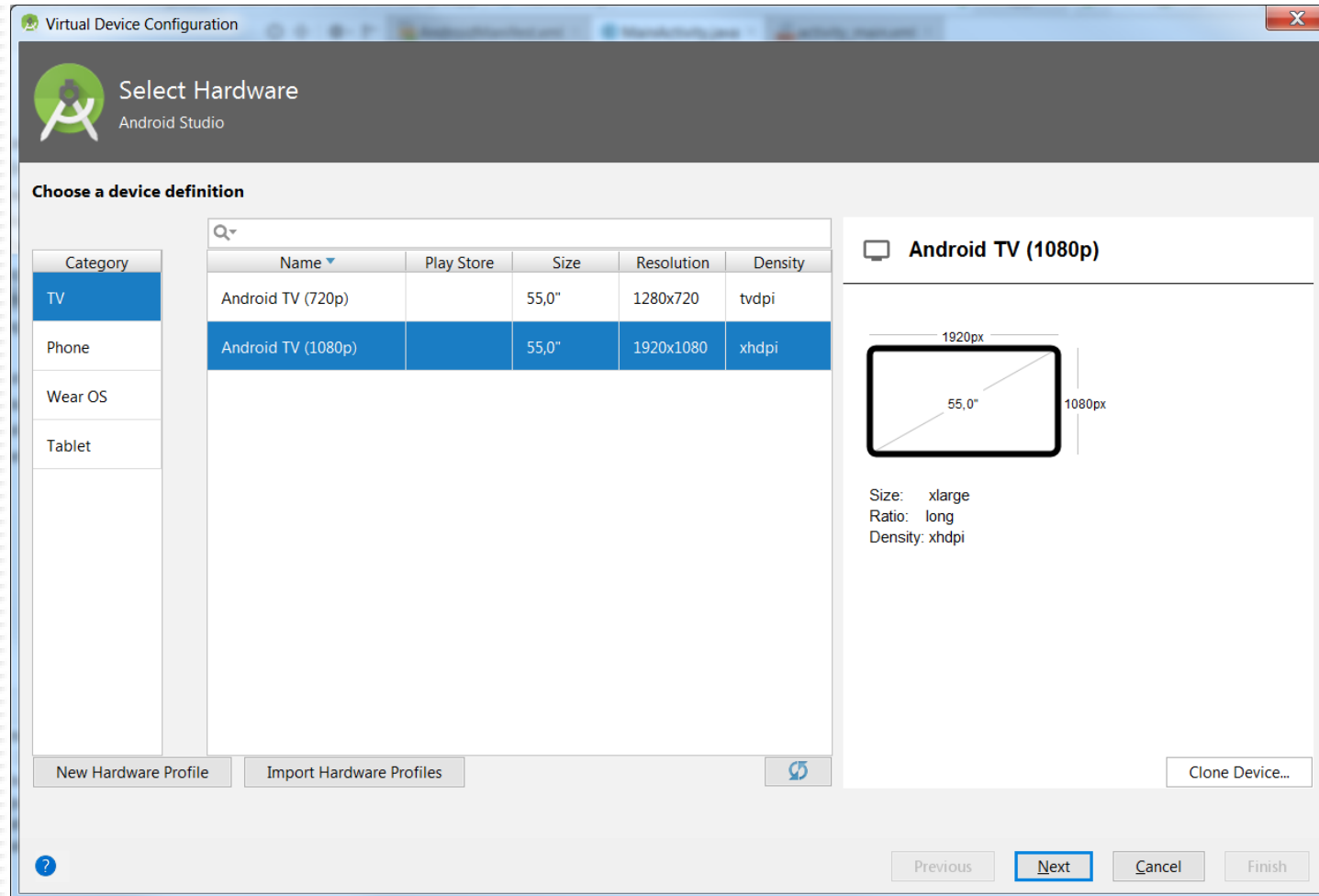
Creating Virtual Device I



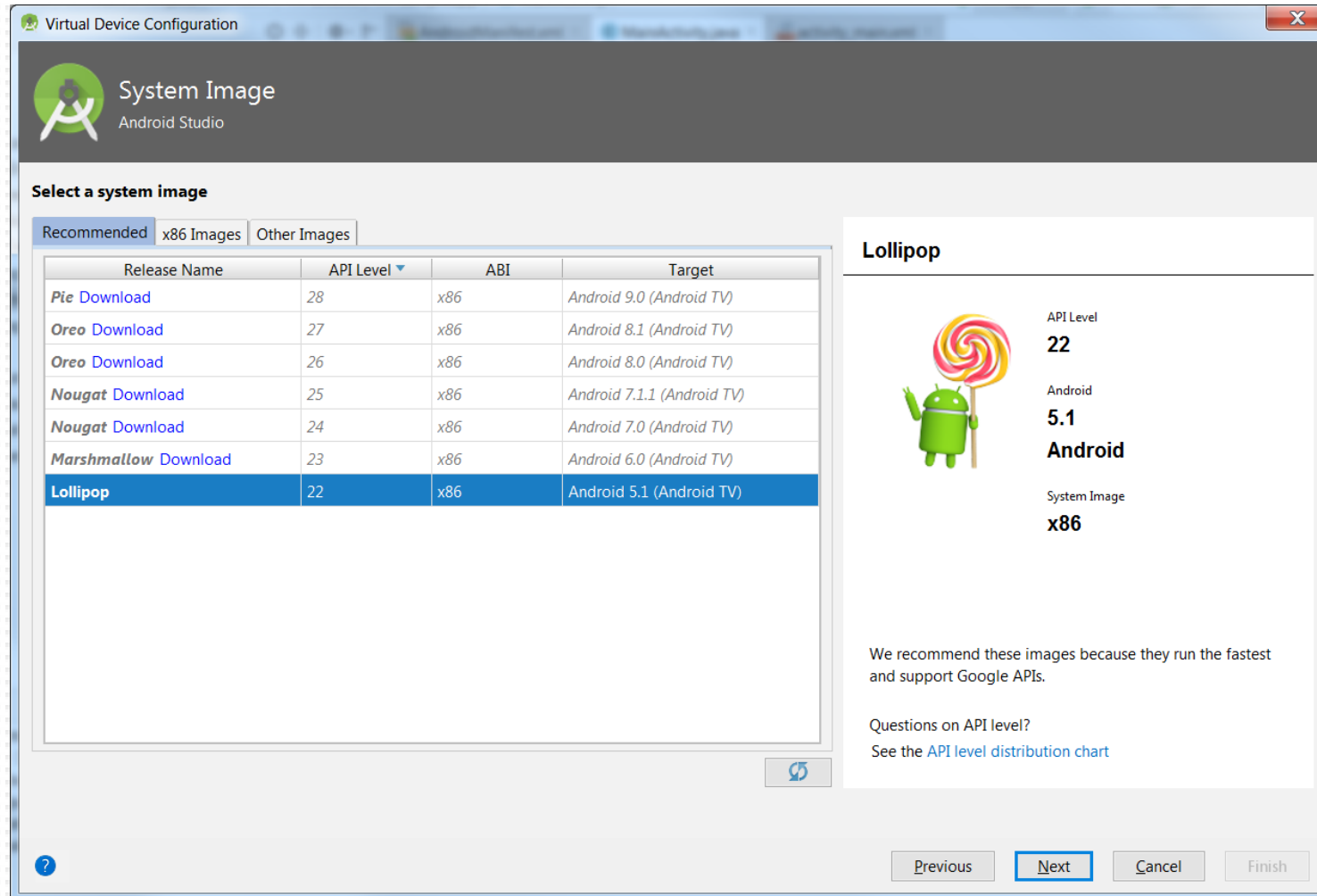
Creating Virtual Device II



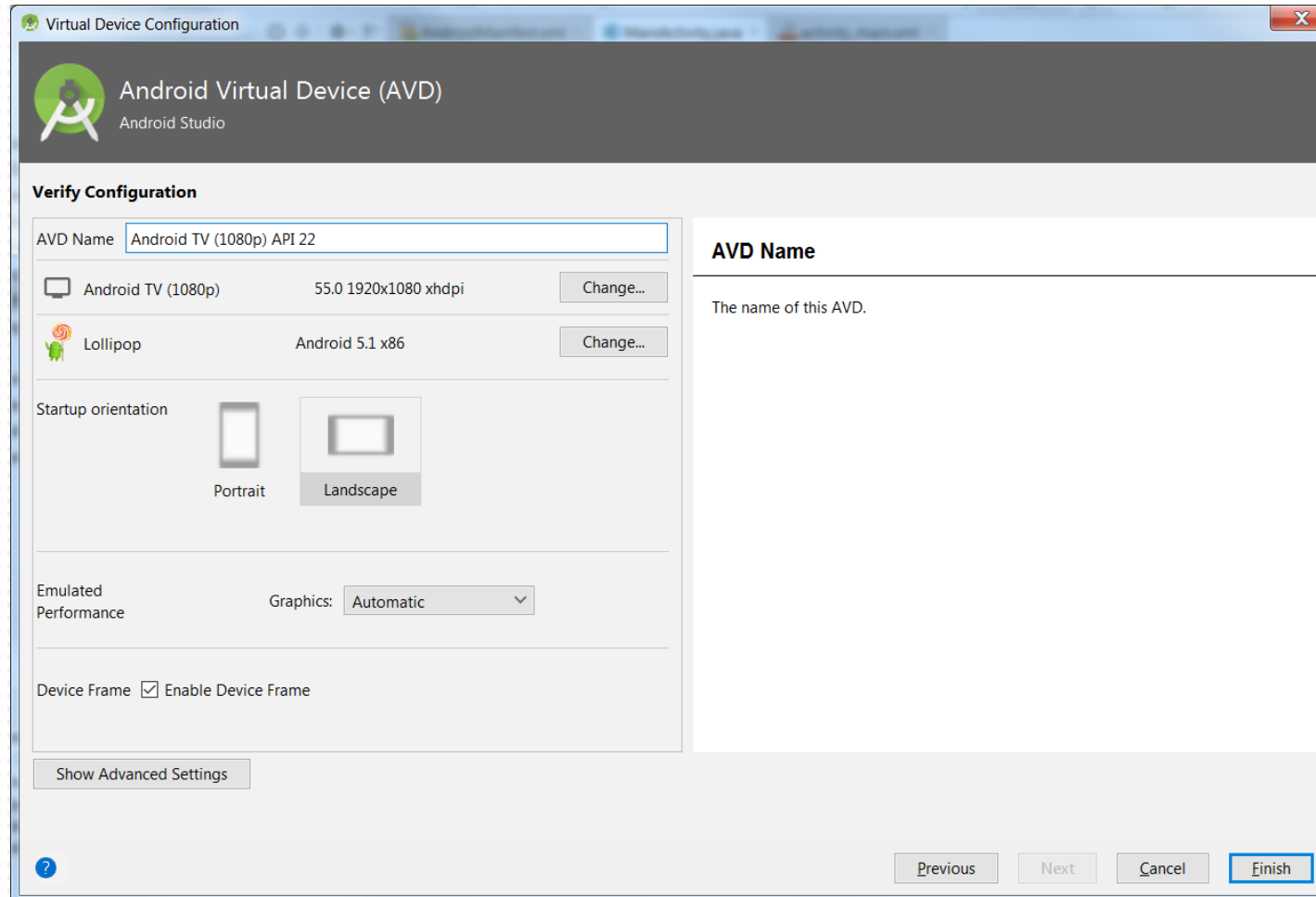
Creating Virtual Device III



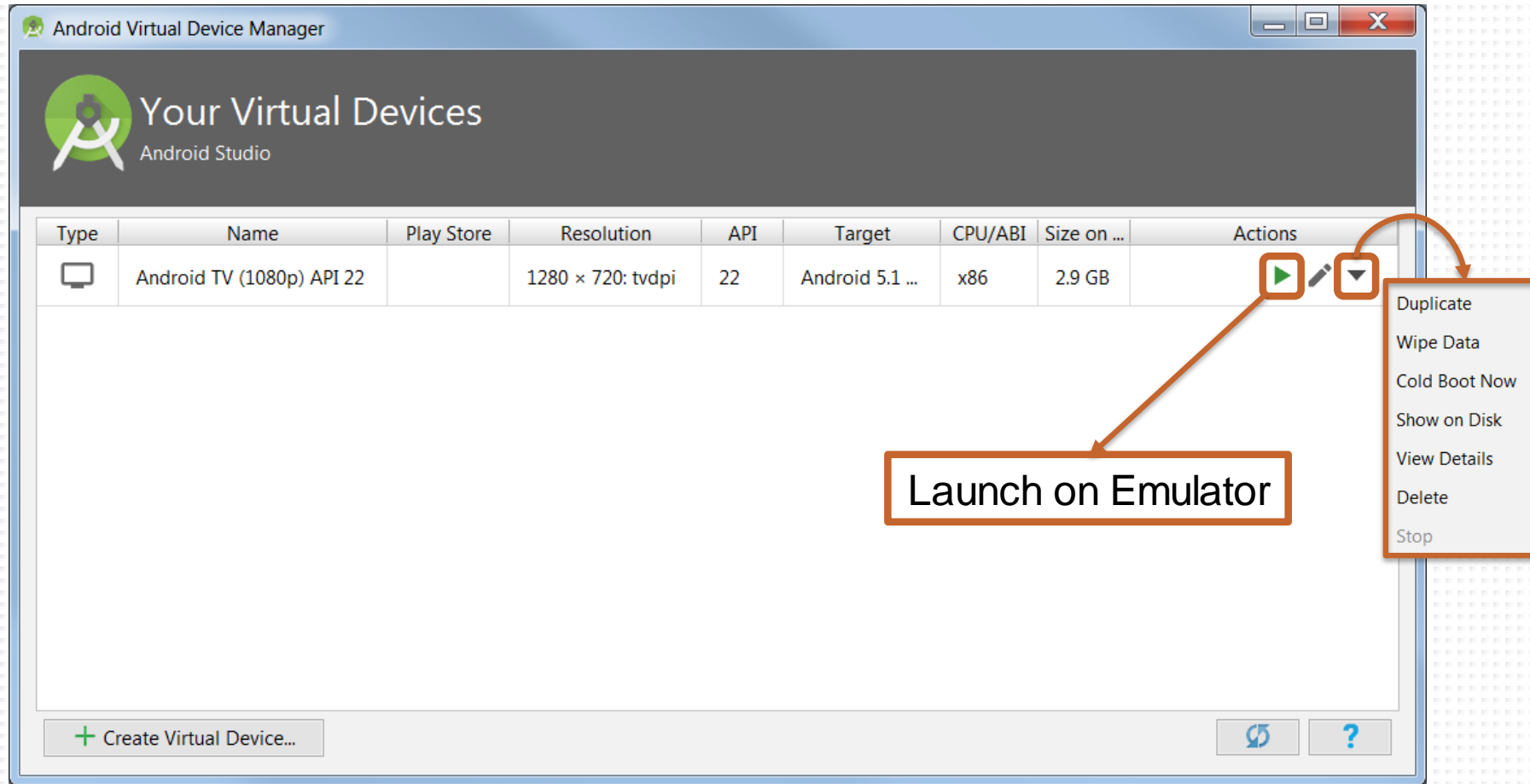
Creating Virtual Device IV



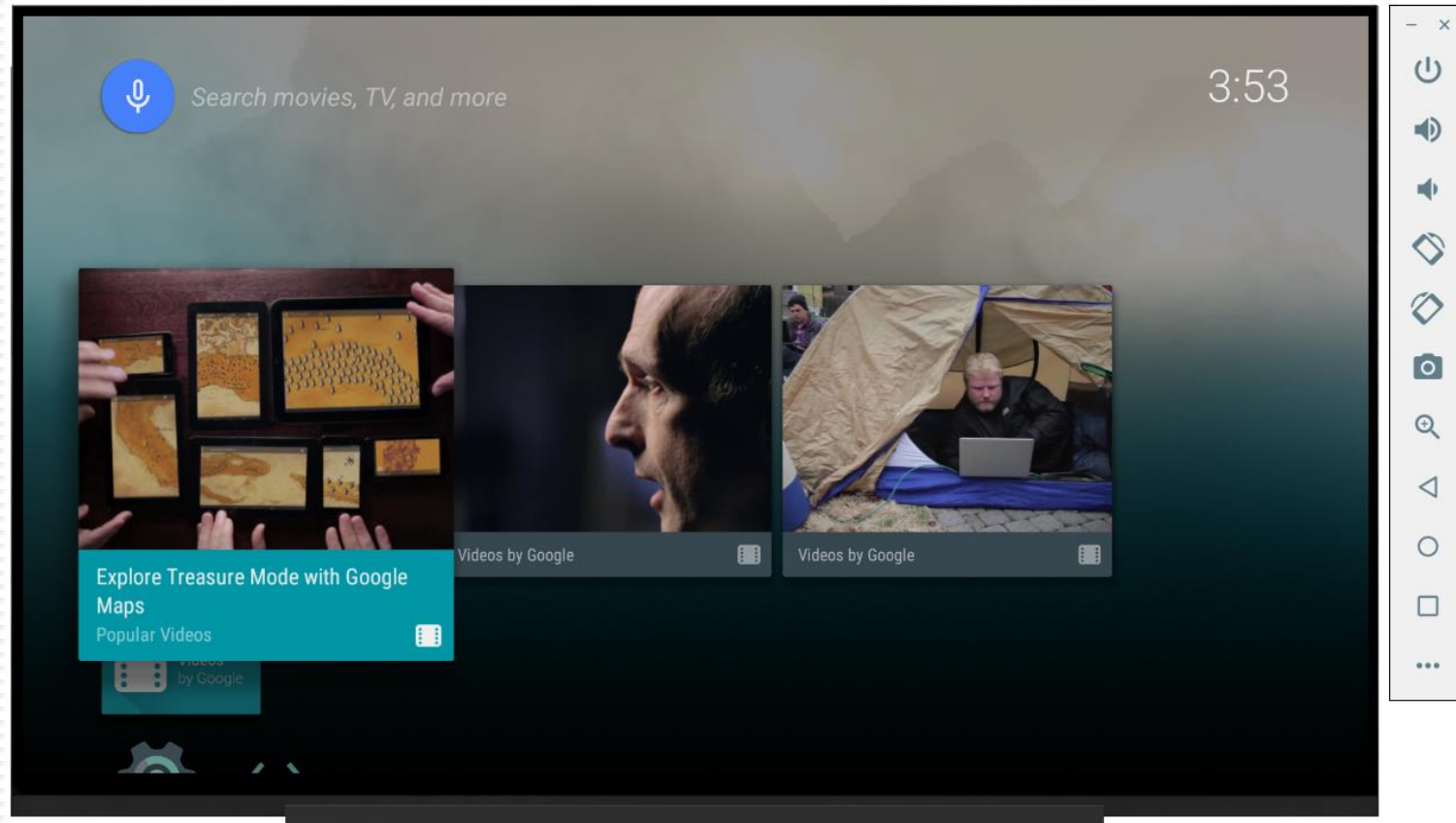
Creating Virtual Device V



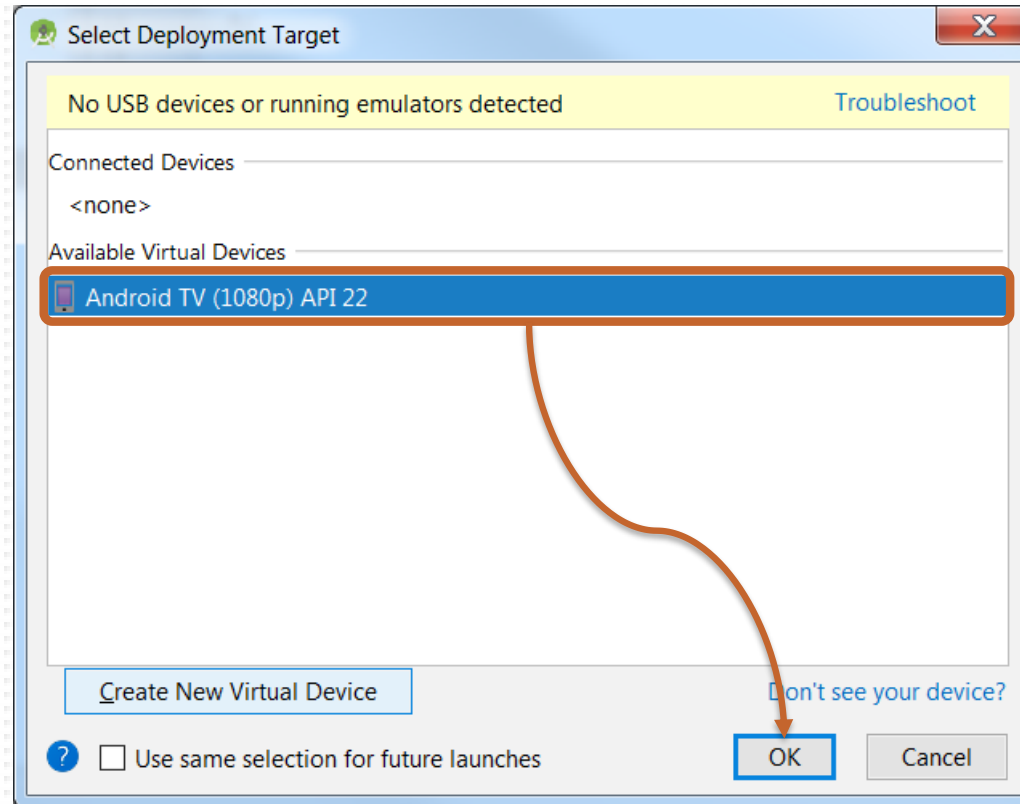
Launching Virtual Device on Emulator



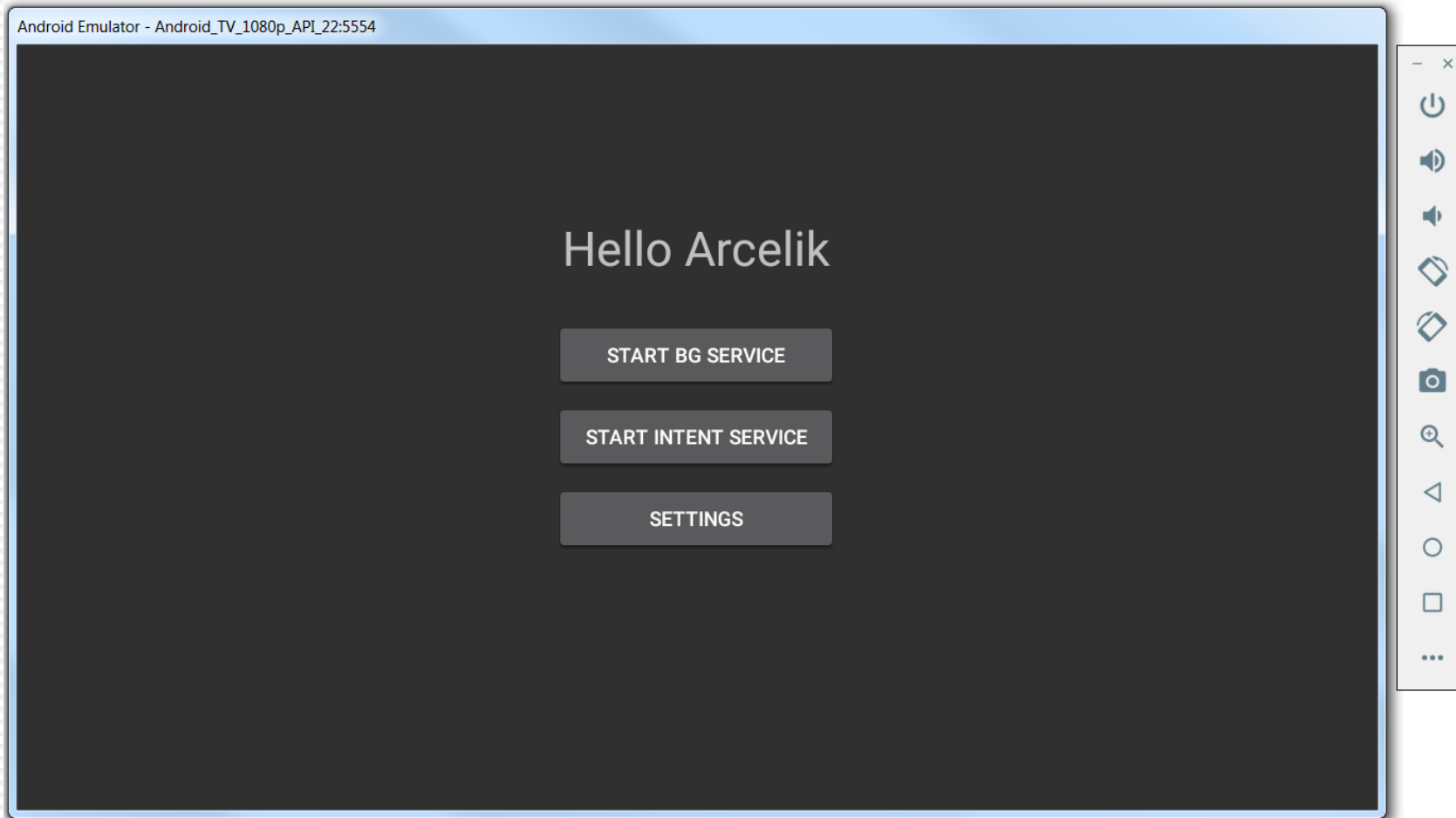
Launching Virtual Device on Emulator II



Running App on Emulator I



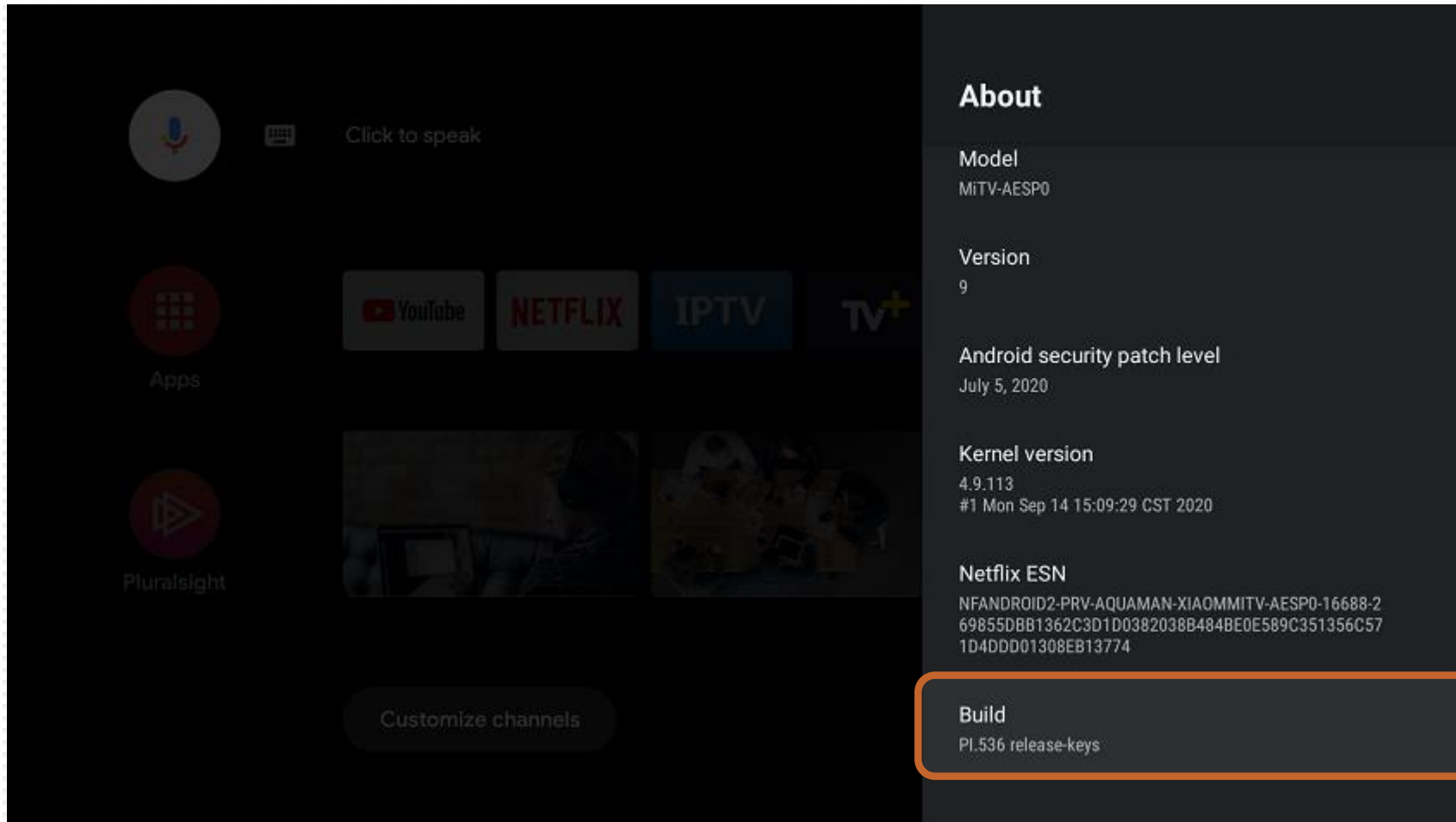
Running App on Emulator II



Running App on Device

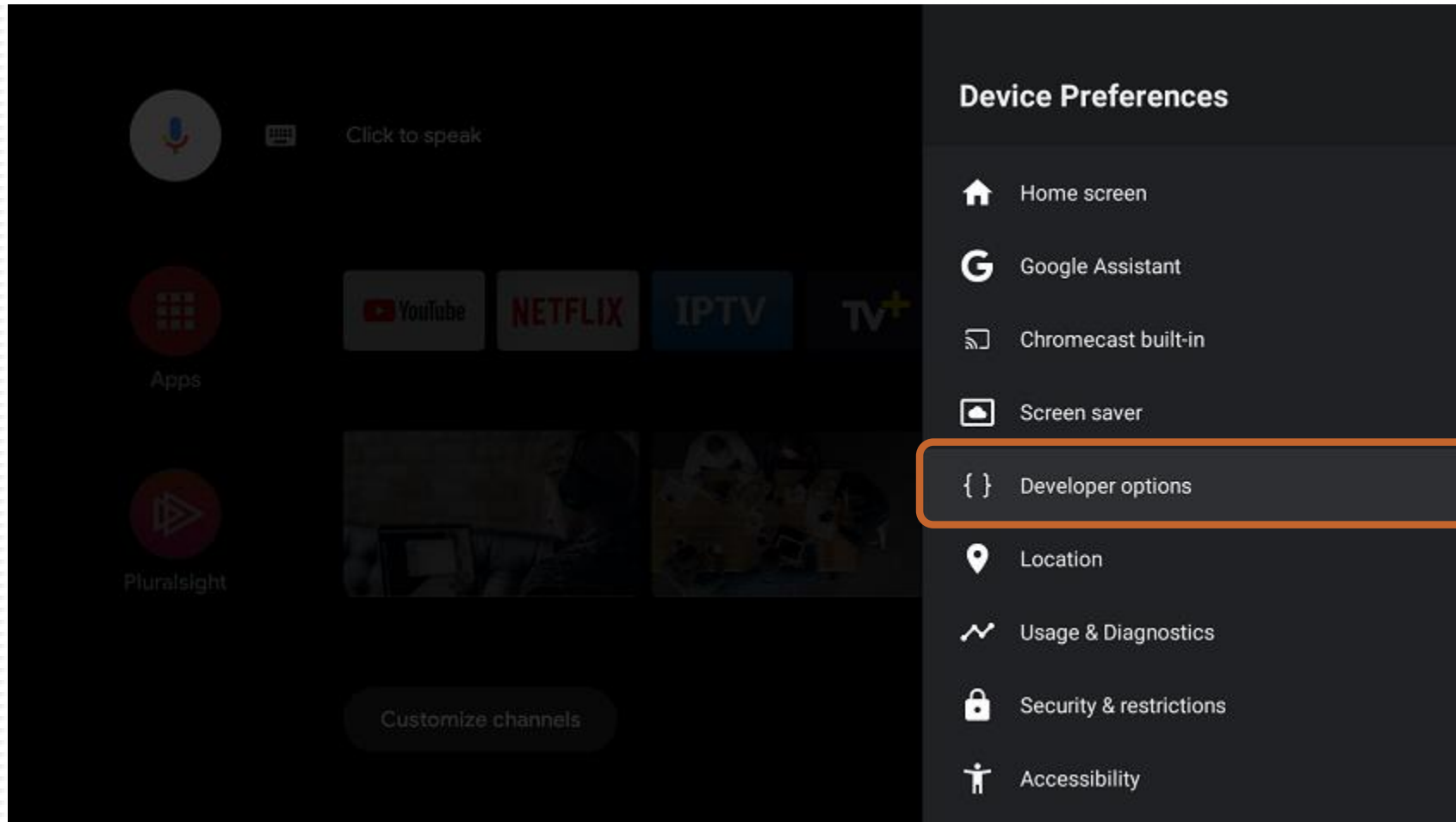
- Android Debug Bridge (adb) tool is used to communicate with a device
- adb can be used with
 - Network
 - USB
- To use adb with a device connected over USB, you must enable **USB debugging** in the device system settings
- To use adb with a device connected over network, you must enable **ADB debugging** in the device system settings

Connect Device (Android TV) over USB I

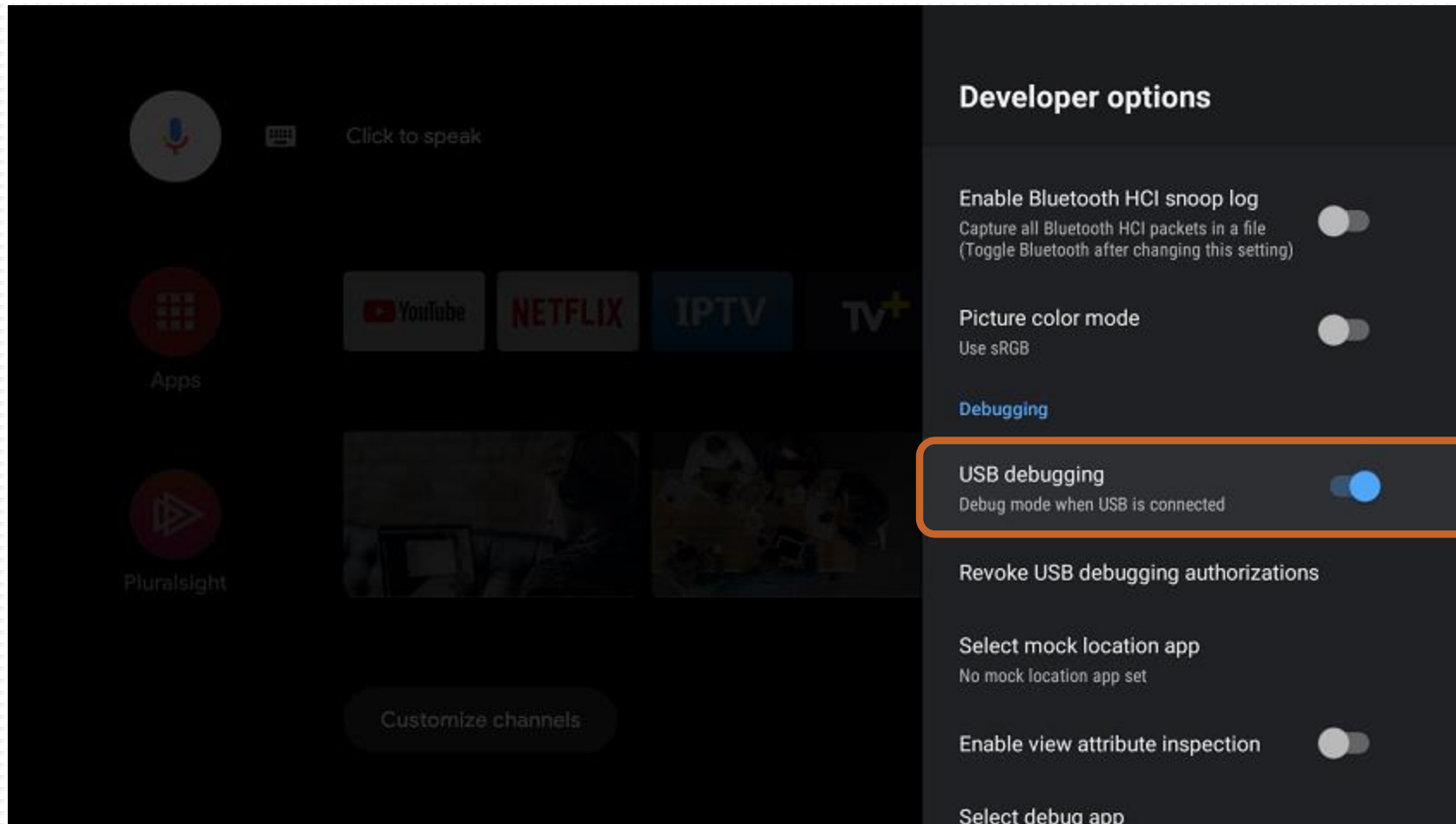


Press 'Build' 5 times to unlock developer options

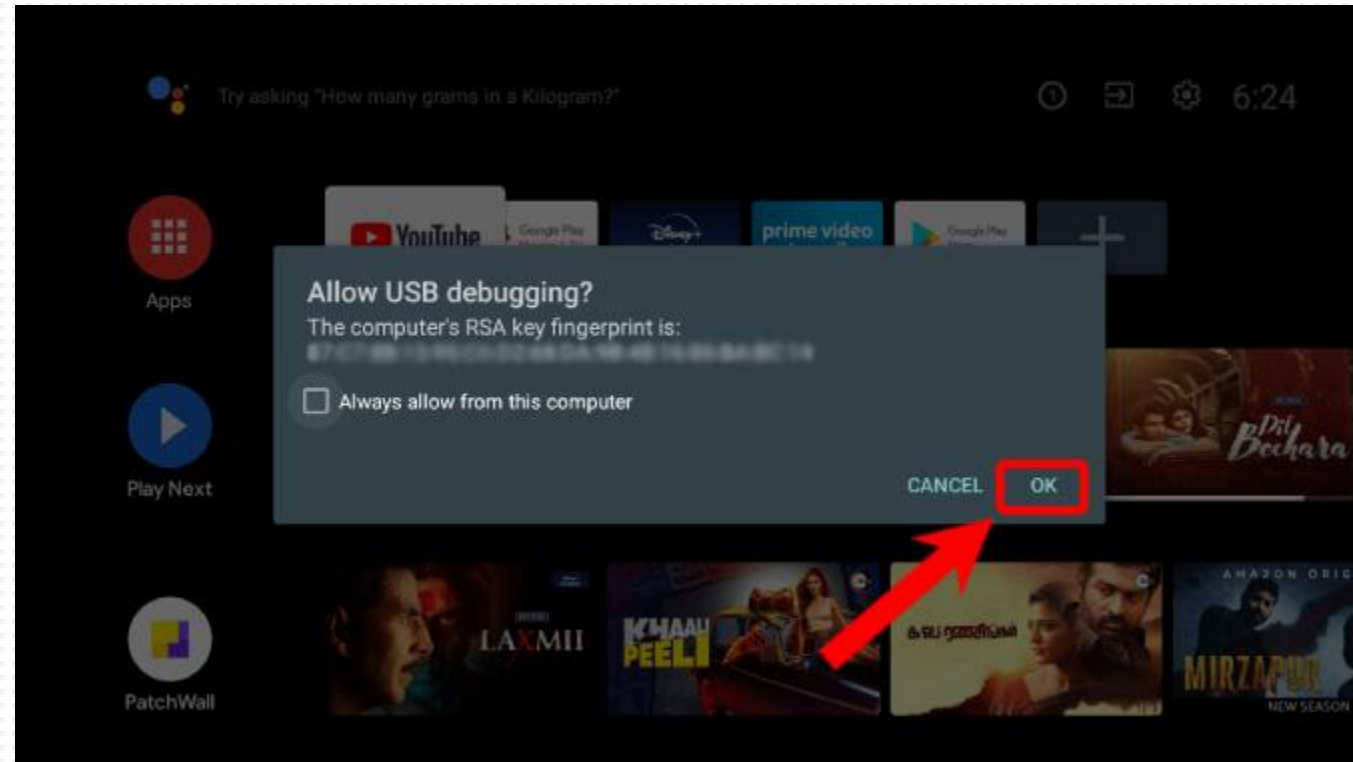
Connect Device (Android TV) over USB II



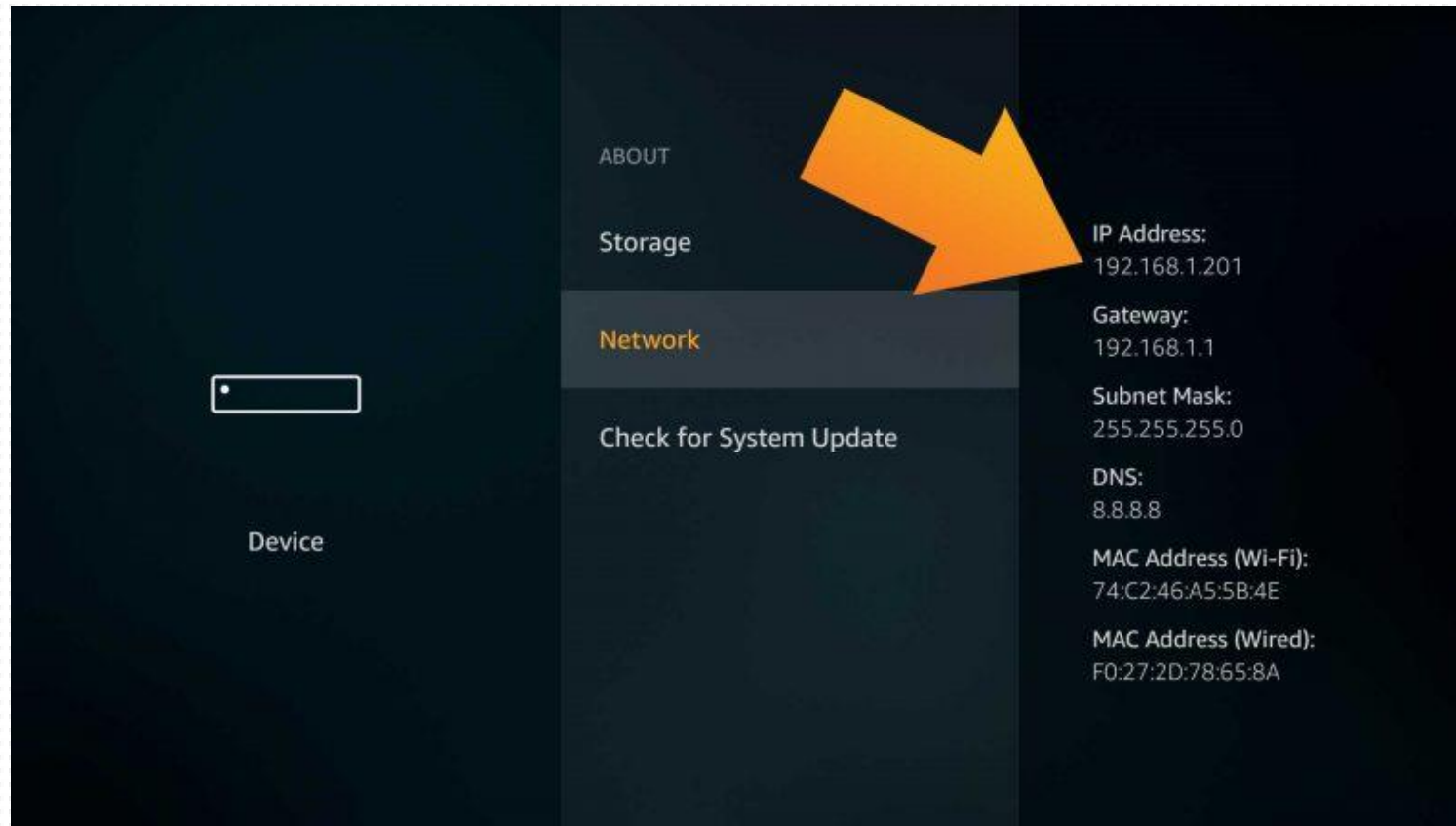
Connect Device (Android TV) over USB III



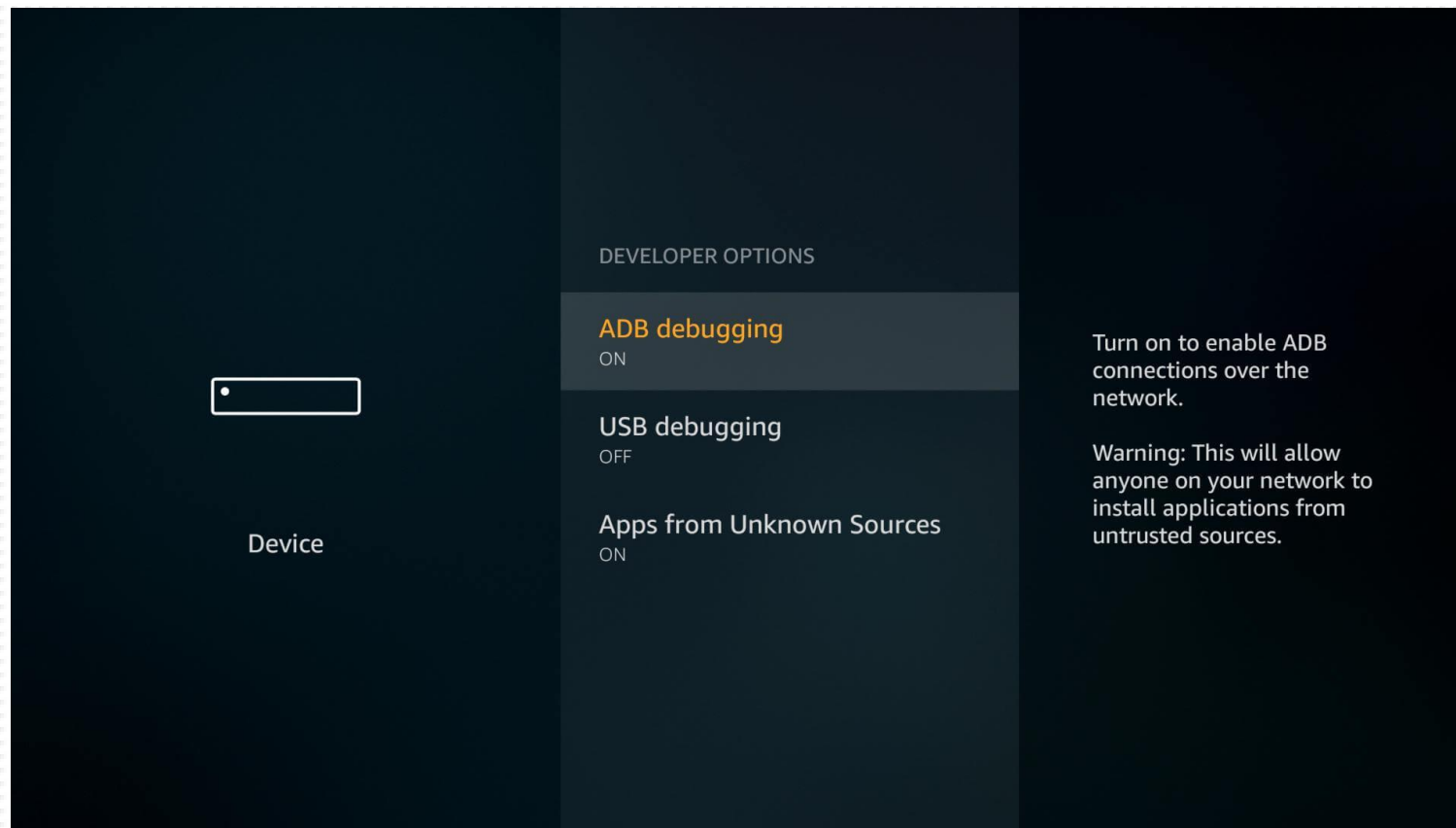
Connect Device (Android TV) over USB IV



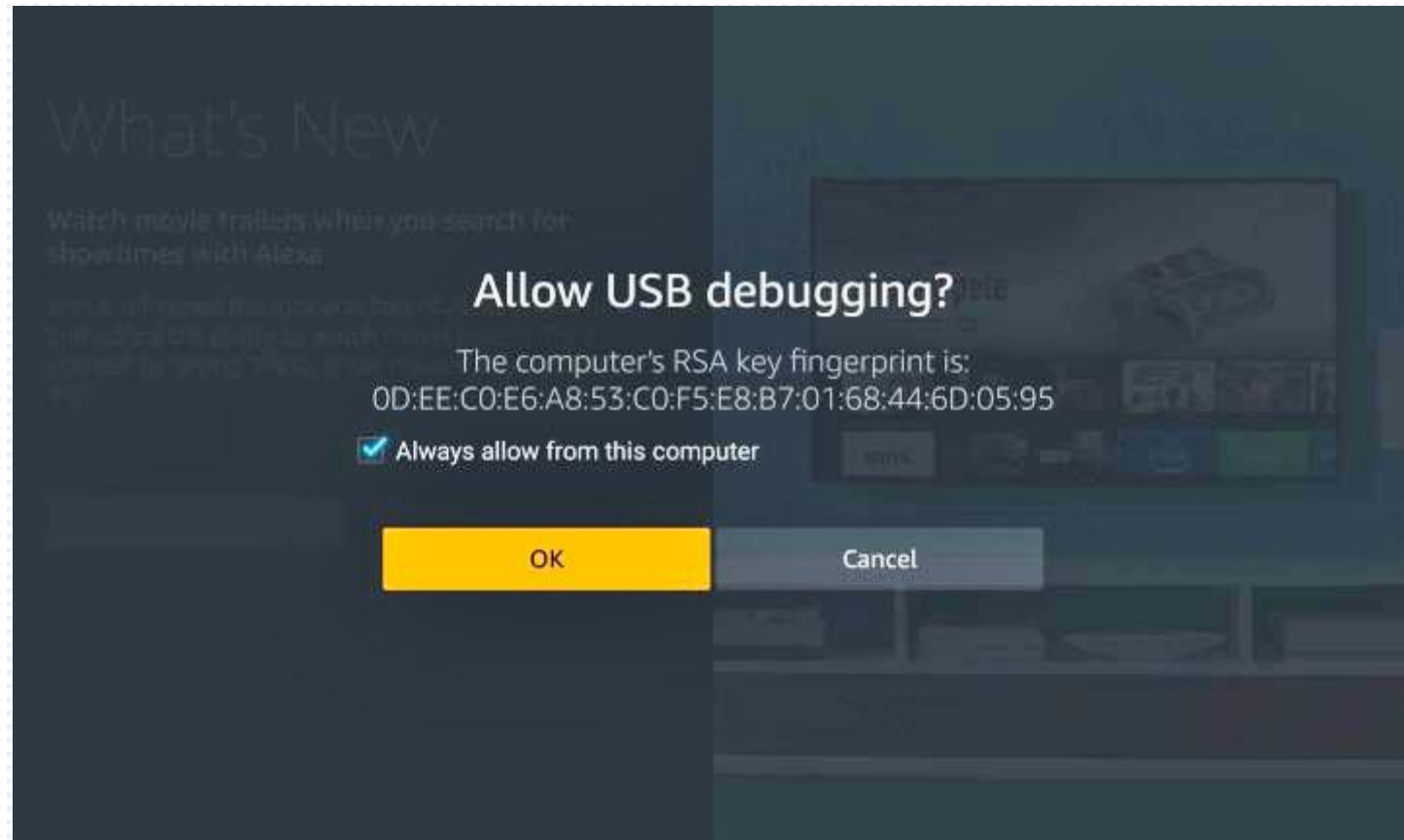
Connect Device (Fire TV) over Network I



Connect Device (Fire TV) over Network II



Connect Device (Fire TV) over Network III



Connect Device (Fire TV) over Network IV

Terminal

```
+ D:\Users\AR430805\AndroidStudioProjects\SampleApplication>cd D:\Users\AR430805\AppData\Local\Android\sdk\platform-tools
X D:\Users\AR430805\AppData\Local\Android\sdk\platform-tools>adb start-server
* daemon not running; starting now at tcp:5037
* daemon started successfully

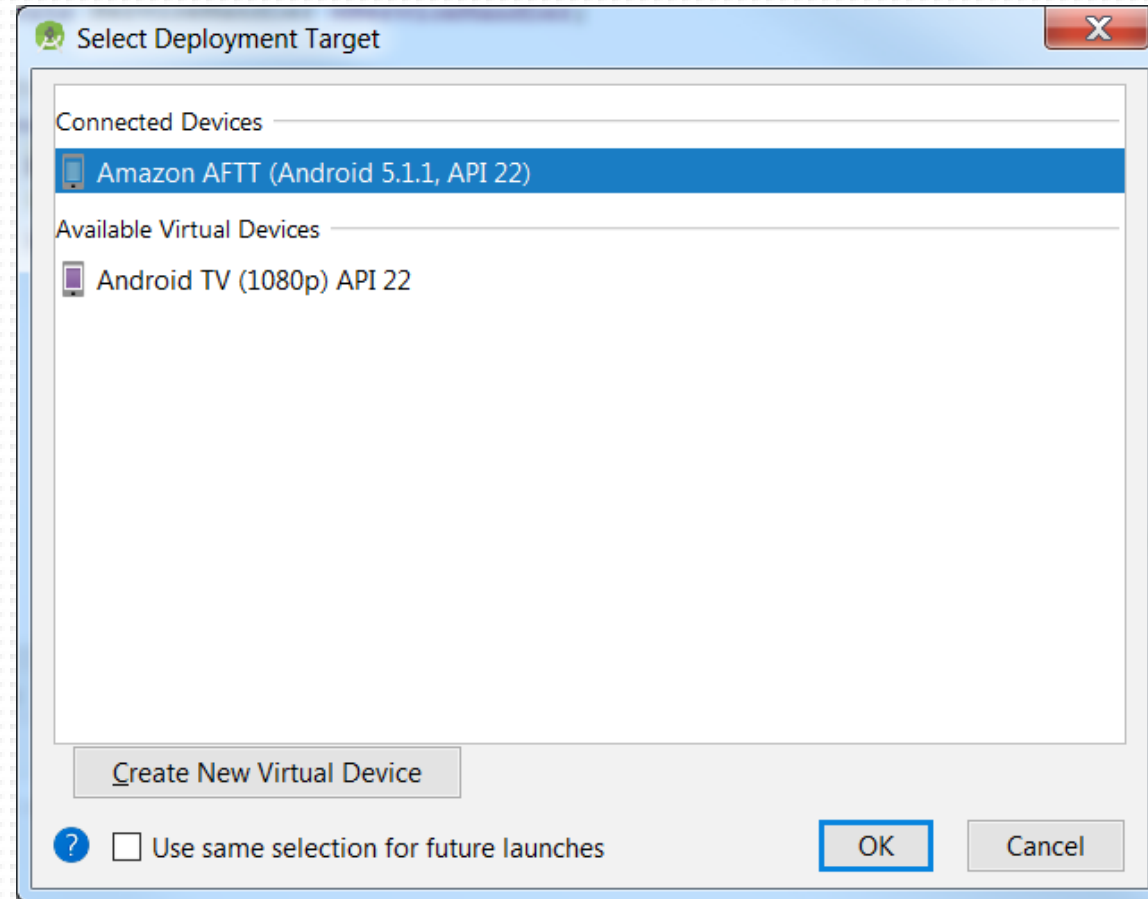
D:\Users\AR430805\AppData\Local\Android\sdk\platform-tools>adb connect 192.168.1.119
^C
D:\Users\AR430805\AppData\Local\Android\sdk\platform-tools>adb connect 192.168.0.119
failed to authenticate to 192.168.0.119:5555

D:\Users\AR430805\AppData\Local\Android\sdk\platform-tools>adb connect 192.168.0.119
already connected to 192.168.0.119:5555

D:\Users\AR430805\AppData\Local\Android\sdk\platform-tools>adb devices
List of devices attached
192.168.0.119:5555      device
192.168.1.119:5555      offline

D:\Users\AR430805\AppData\Local\Android\sdk\platform-tools>
```

Running App on Device (Fire TV)



Installing App on Device (Fire TV)

- You can also install external apk files to Android devices
- "Apps from Unknown Sourced" option should be 'ON' in developer options menu

```
Terminal
+ D:\Users\AR430805\AppData\Local\Android\sdk\platform-tools>adb start-server
X D:\Users\AR430805\AppData\Local\Android\sdk\platform-tools>adb connect 192.168.0.116
connected to 192.168.0.116:5555

D:\Users\AR430805\AppData\Local\Android\sdk\platform-tools>adb install -r D:\lifecell_v1.09.apk
[ 40%] /data/local/tmp/lifecell_v1.09.apk
```

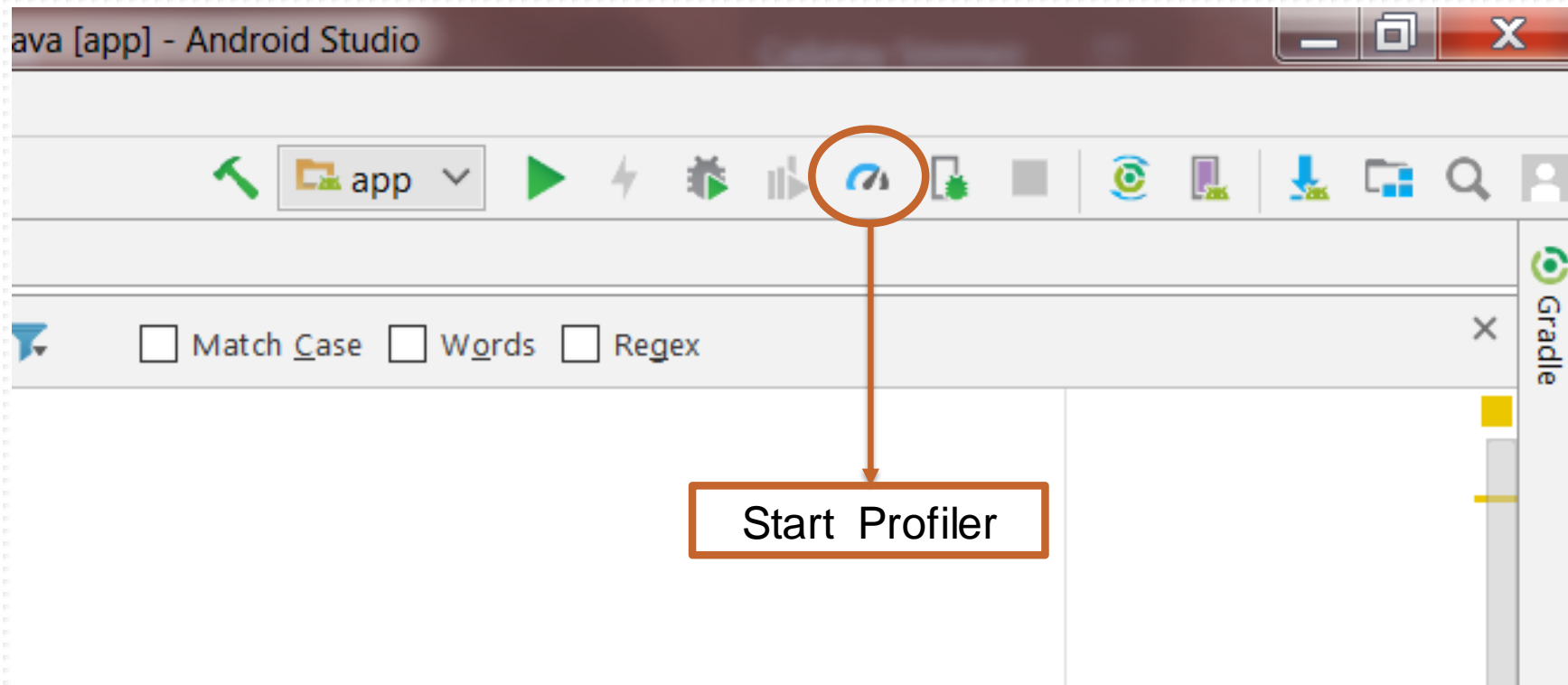
6: Logcat Terminal 91% Build TODO

adb install options

Command	Action
adb install test.apk	
adb install -l test.apk	forward lock application
adb install -r test.apk	replace existing application
adb install -t test.apk	allow test packages
adb install -s test.apk	install application on sdcard
adb install -d test.apk	allow version code downgrade
adb install -p test.apk	partial application install

Monitoring App Performance

- Use Profiler to monitor the resource usage of your application



Profiler

Stop Session

Pause/Resume Live Monitoring

Profiler com.arcelik.sampleapplication (Emulator Android_TV_1080p_API_22)

SESSIONS + [red square icon]

14:50 ●
sampleapplication (Emulator Androi...
16 min 43 sec

Advanced profiling is unavailable for the selected process
Configure this setting in the [Run Configuration](#)

CPU 2 %
100 %

MEMORY 11,9 MB
16 MB

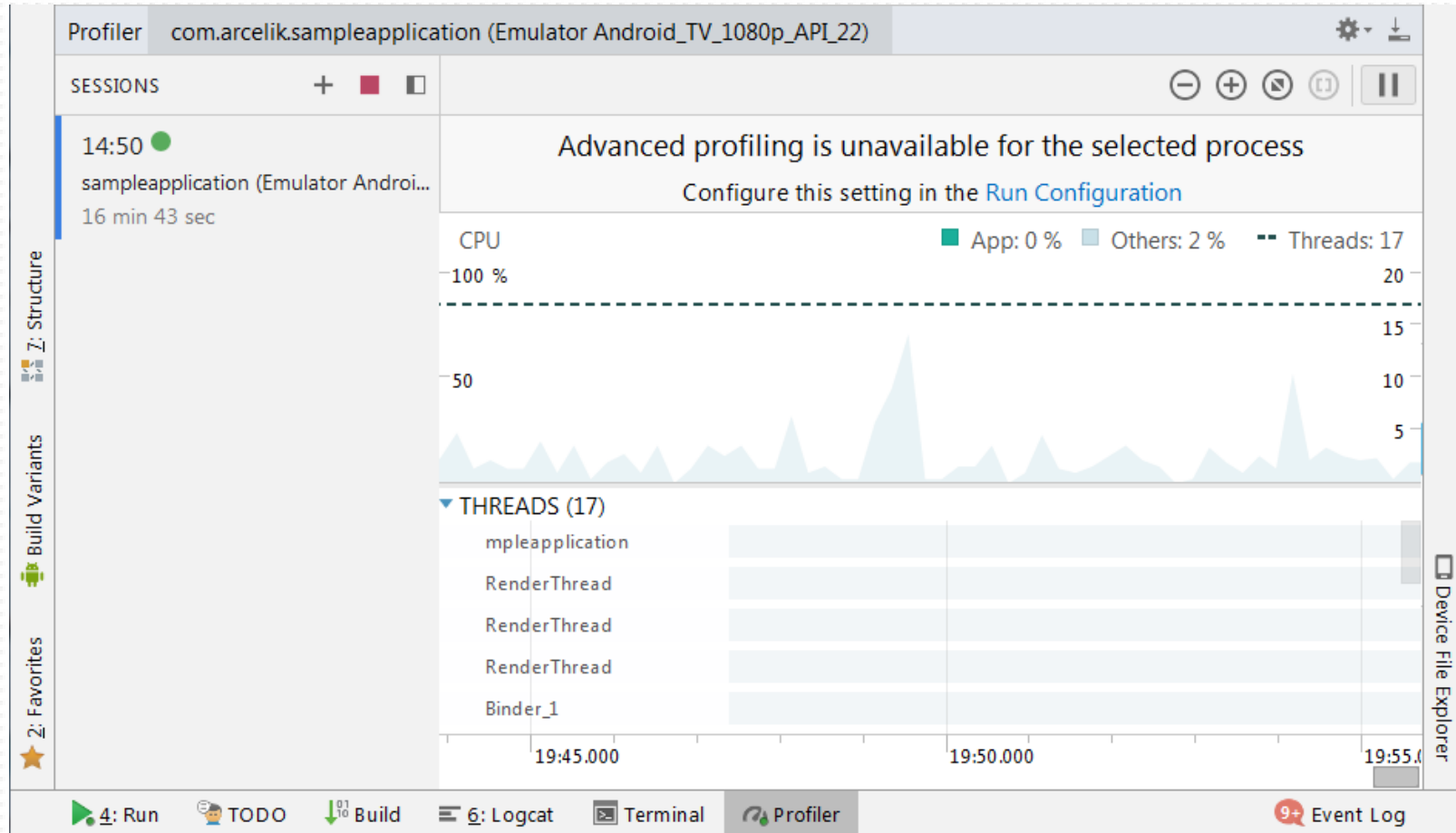
NETWORK Sending: 0 B/s Receiving: 0 B/s
4 B/s

Energy profiler unavailable
Supported only on devices running Android 8.0 (API level 26) and higher. [Learn More](#)

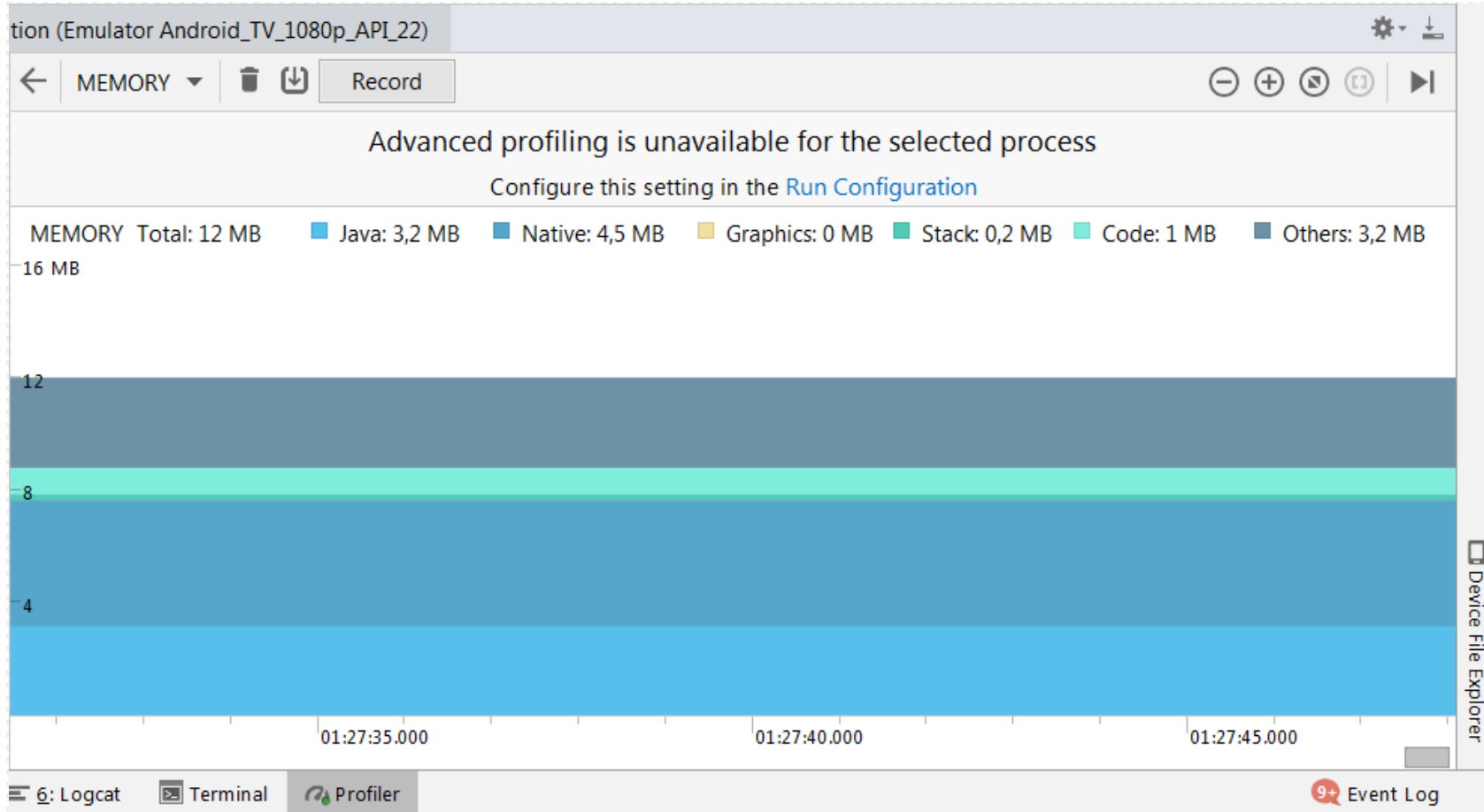
16:35.000 16:40.000

4: Run TODO Build 6: Logcat Terminal Profiler 9+ Event Log

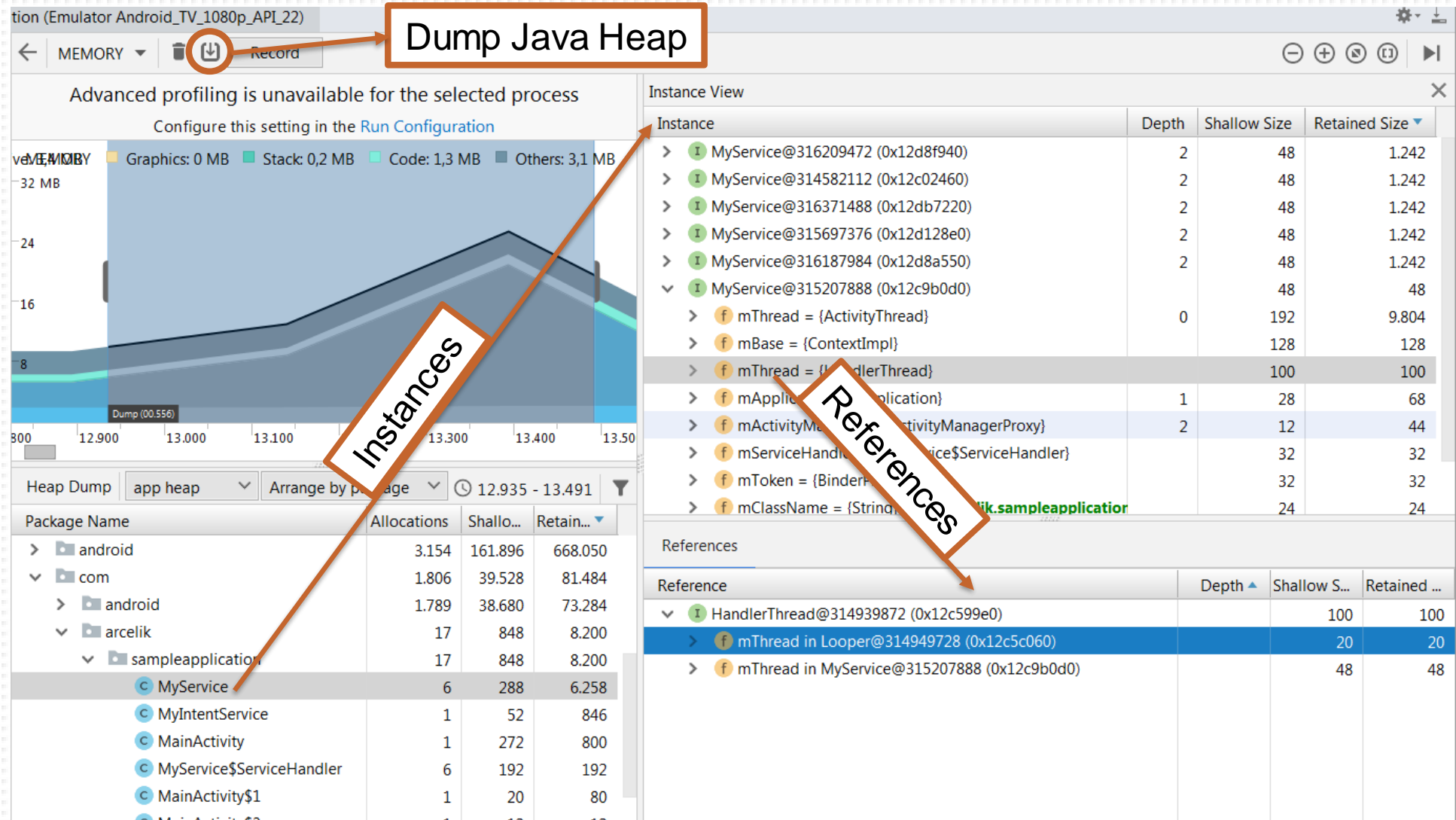
Profiler - CPU Usage



Profiler - Memory Usage



Profiler - Java Heap



Debugging

- Android Studio provides a debugger to debug application
 - View logs
 - Attach the debugger to a running app
 - Use breakpoints
 - Analyze stack trace
 - View on-device files
 - Take screenshot
 - Record a video

Viewing System Logs

The screenshot displays the Android Studio interface with the `MyService.java` file open in the editor. The Logcat window at the bottom shows a log entry from the `com.arcelik.sampleapplication` app, filtered by the `VERBOSE` level and the `SAMPLE_APP_SERVICE` tag. The log message is: `D/SAMPLE_APP_SERVICE: handleMessage: { when=0 what=0 arg1=1 target=com.arcelik.sampleapplication.MyService$ServiceHa`.

Annotations in the image point to the following elements:

- App Filter**: Points to the `com.arcelik.sampleapplic` filter in the Logcat window.
- Debug Level**: Points to the `Verbose` level dropdown in the Logcat window.
- Search**: Points to the `SAMPLE_APP_SERVICE` search tag in the Logcat window.
- Printing Log**: Points to the `Log.d(TAG_SERVICE, msg; "handleMessage: " + msg;);` line in the `MyService.java` file.
- Logcat**: Points to the Logcat window itself.

```
import android.widget.Toast;

public class MyService extends Service {
    public static final String TAG_SERVICE = "SAMPLE_APP_SERVICE";

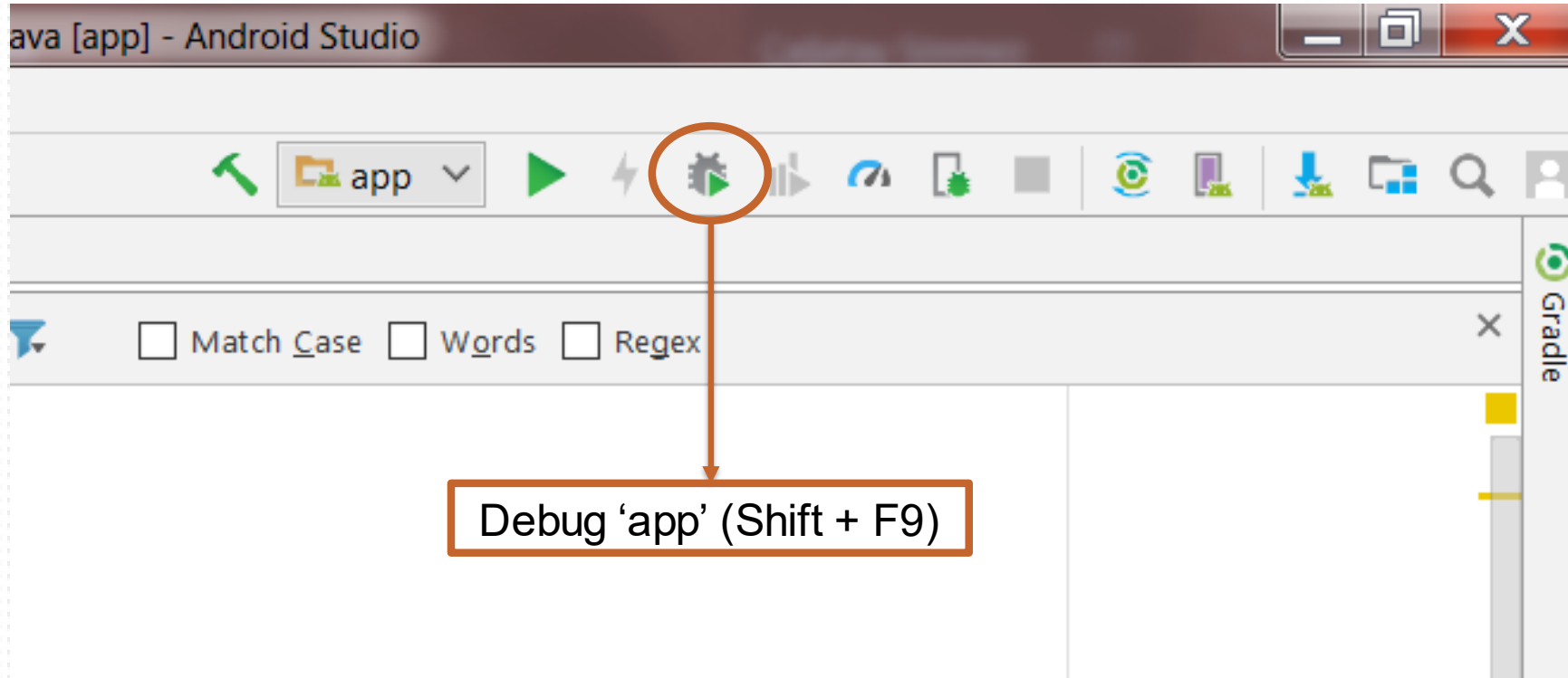
    private Loopor mServiceLoopor;
    private ServiceHandler mServiceHandler;

    // Handler that receives messages from the thread
    private final class ServiceHandler extends Handler {
        public ServiceHandler(Loopor loopor) {
            super(loopor);
        }

        @Override
        public void handleMessage(Message msg) {
            Log.d(TAG_SERVICE, msg; "handleMessage: " + msg;);

            // Normally we would do some work here, like download a file.
            // For our sample, we just sleep for 5 seconds.
            try {
                Thread.sleep(5000);
            } catch (InterruptedException e) {
                e.printStackTrace();
            }
            Toast.makeText(getApplicationContext(), "Toast message from MyService!", Toast.LENGTH_SHORT).show();
        }
    }
}
```

Starting Debugger



Using Breakpoint I

The screenshot illustrates the process of using a breakpoint in an Android application. The main editor shows the `onClick` method of `MainActivity`. A red circle with a white checkmark on line 29 indicates a breakpoint is set at `stopService(intent);`. An orange arrow labeled "Break Point" points to this location. Below the code, the "Frames" panel shows the current execution frame: `onClick:29, MainActivity$1 (com.arcelik.sampleapplication)`. An orange arrow labeled "Current Frame" points to this entry. To the right, the "Variables" panel displays the state of variables at the breakpoint, including `this`, `v`, and various UI-related fields like `mAllowTransformationLengthChange`, `mBoring`, `mBufferType`, etc. An orange arrow labeled "Changing Variable" points to the `Set Value...` option in the context menu that is open over the variables panel. The context menu also includes options like "New Watch...", "Inspect...", "Copy Value", and "Evaluate Expression...".

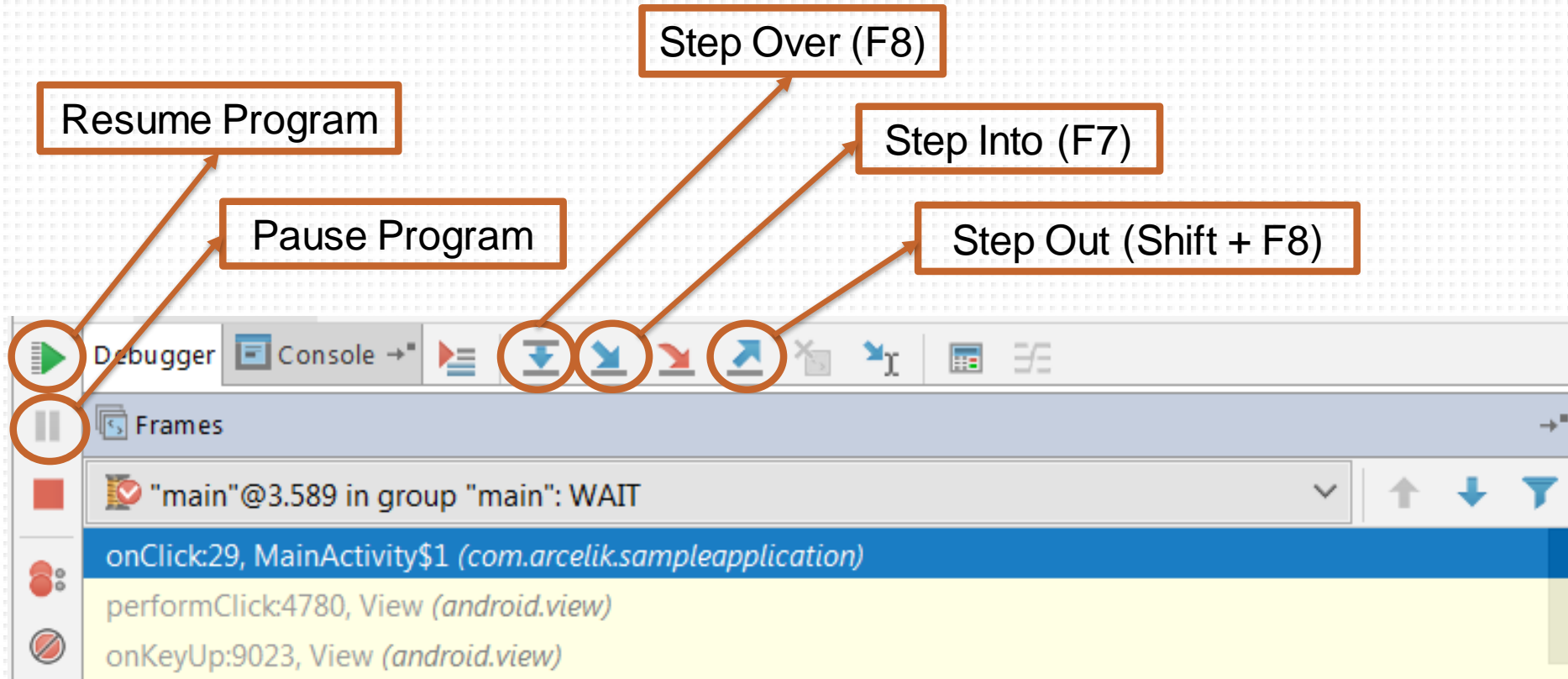
Break Point

Changing Variable

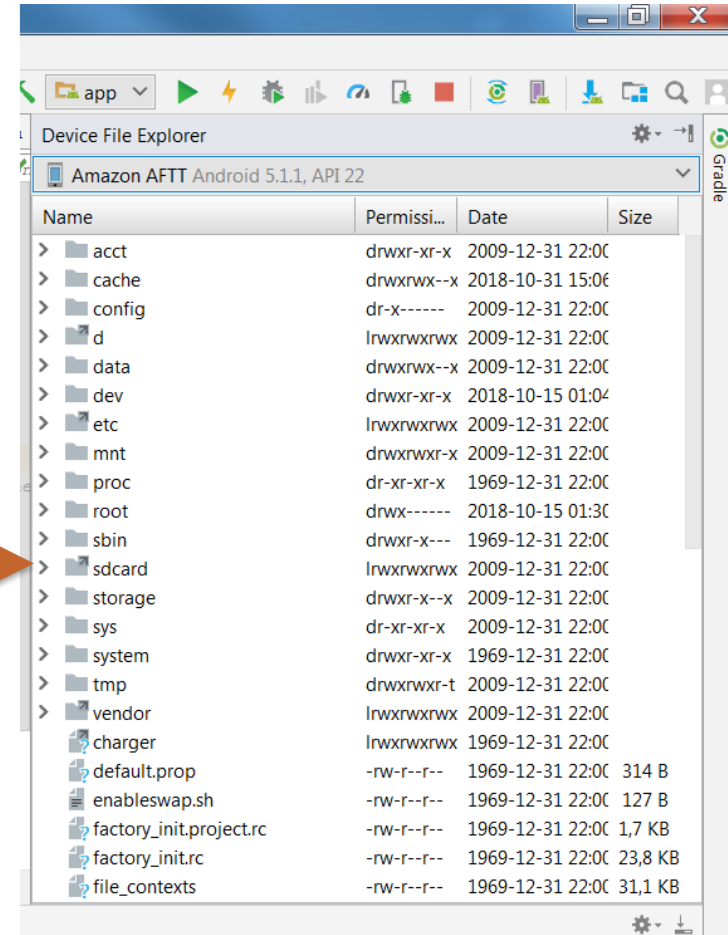
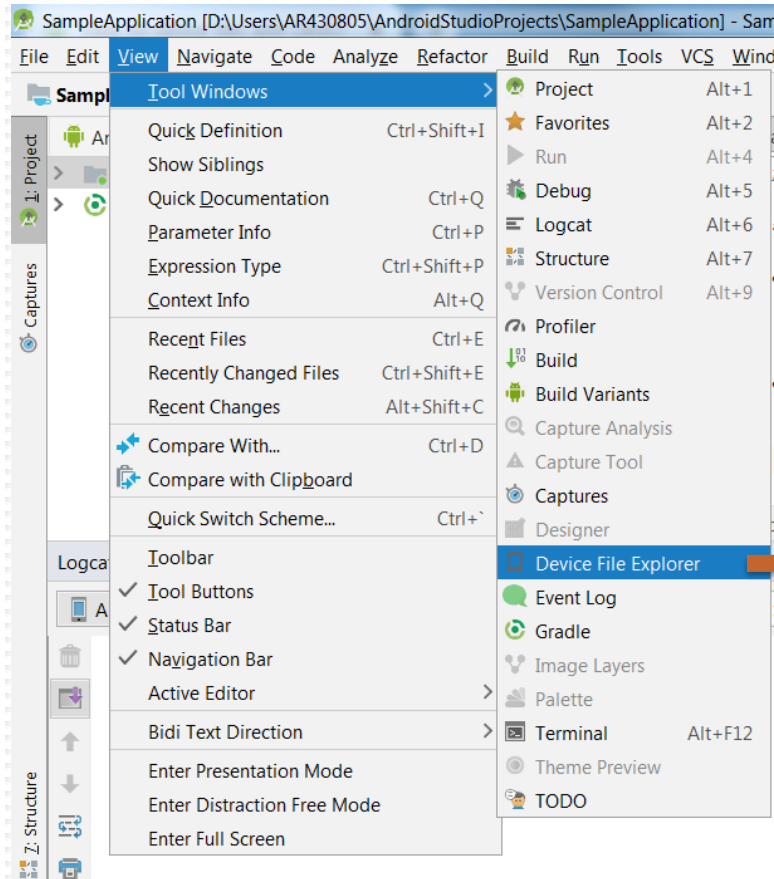
Current Frame

Variables

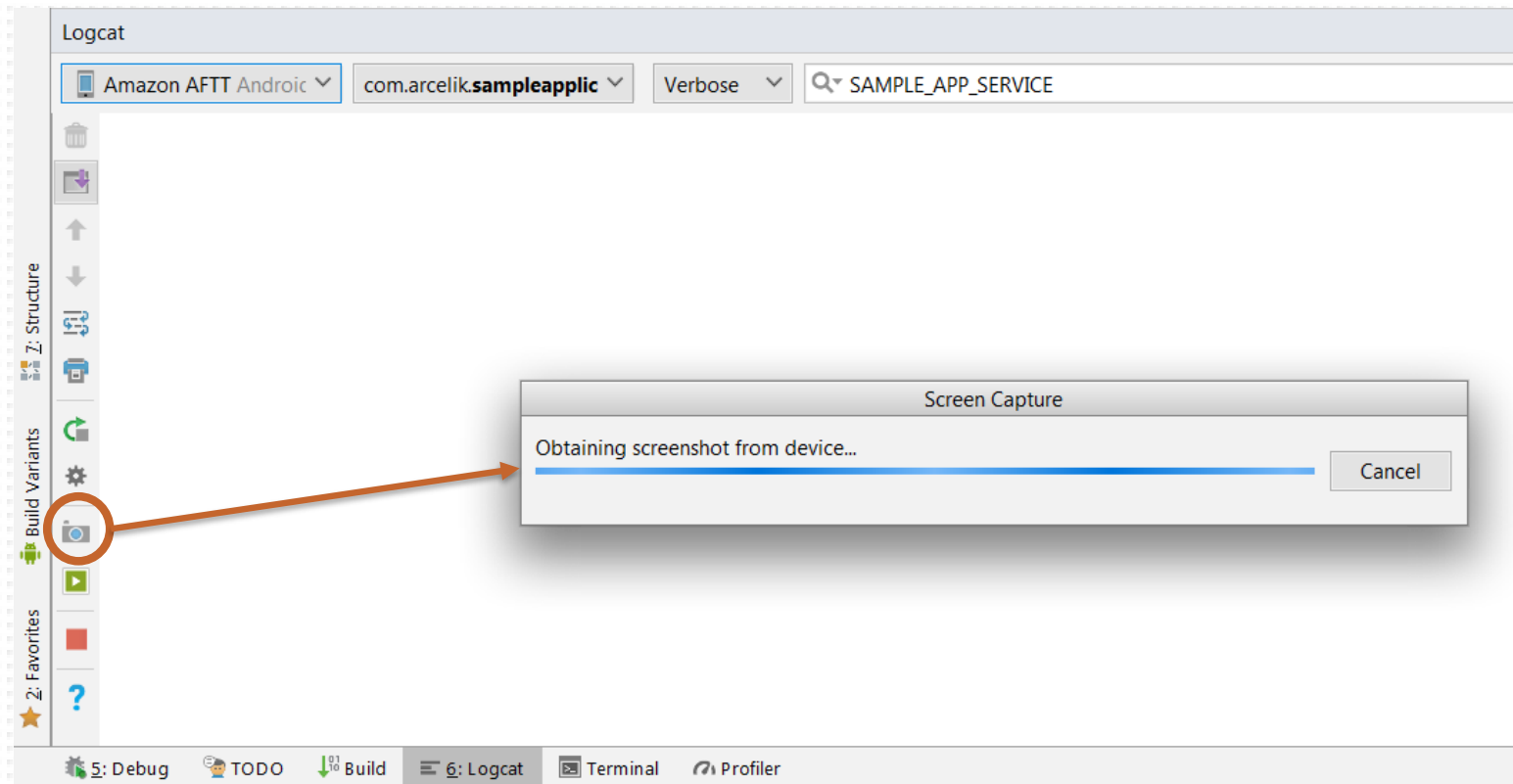
Using Breakpoint II



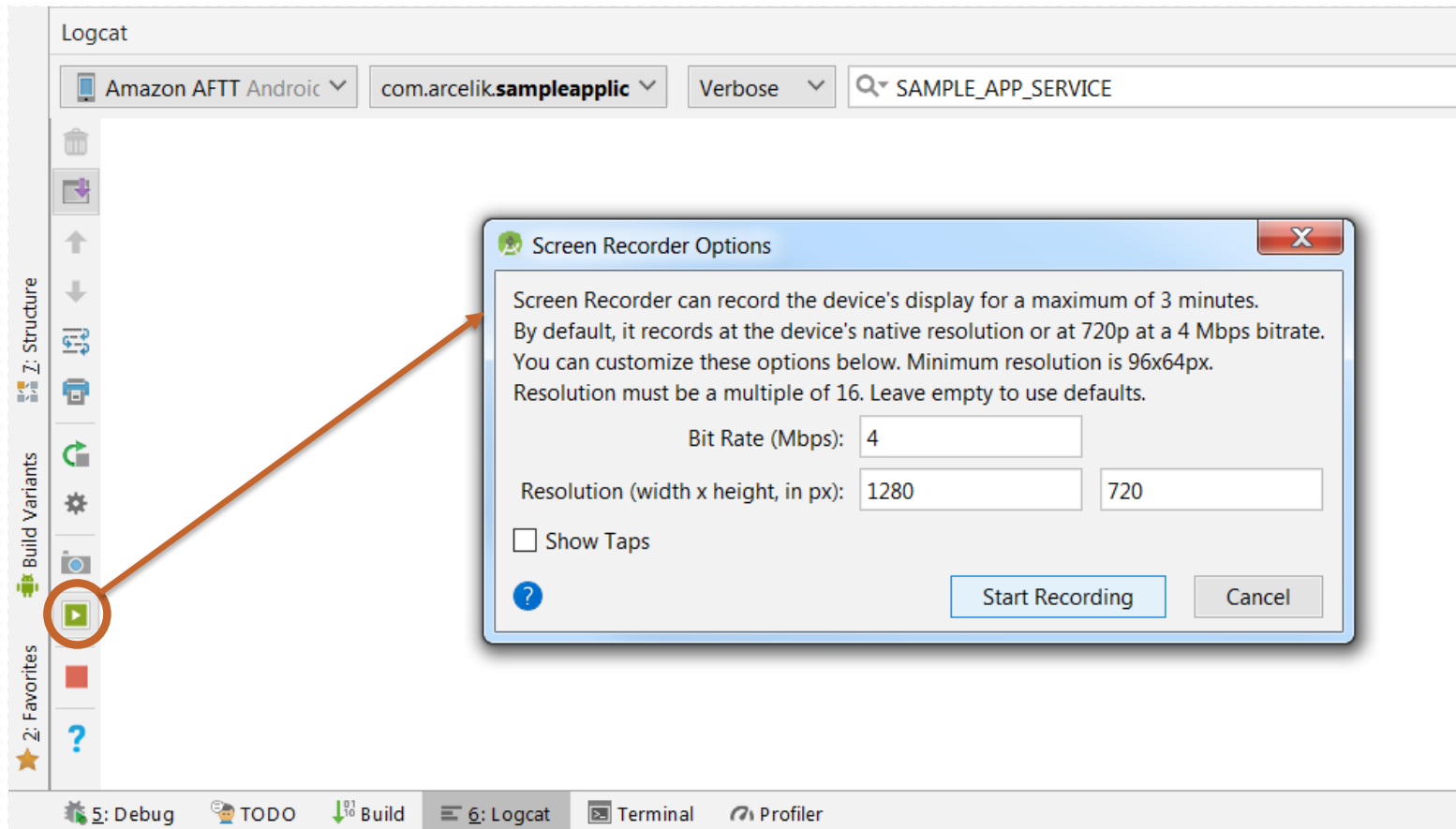
View On-Device Files



Take screenshot



Record Video



QUESTIONS?