# android things

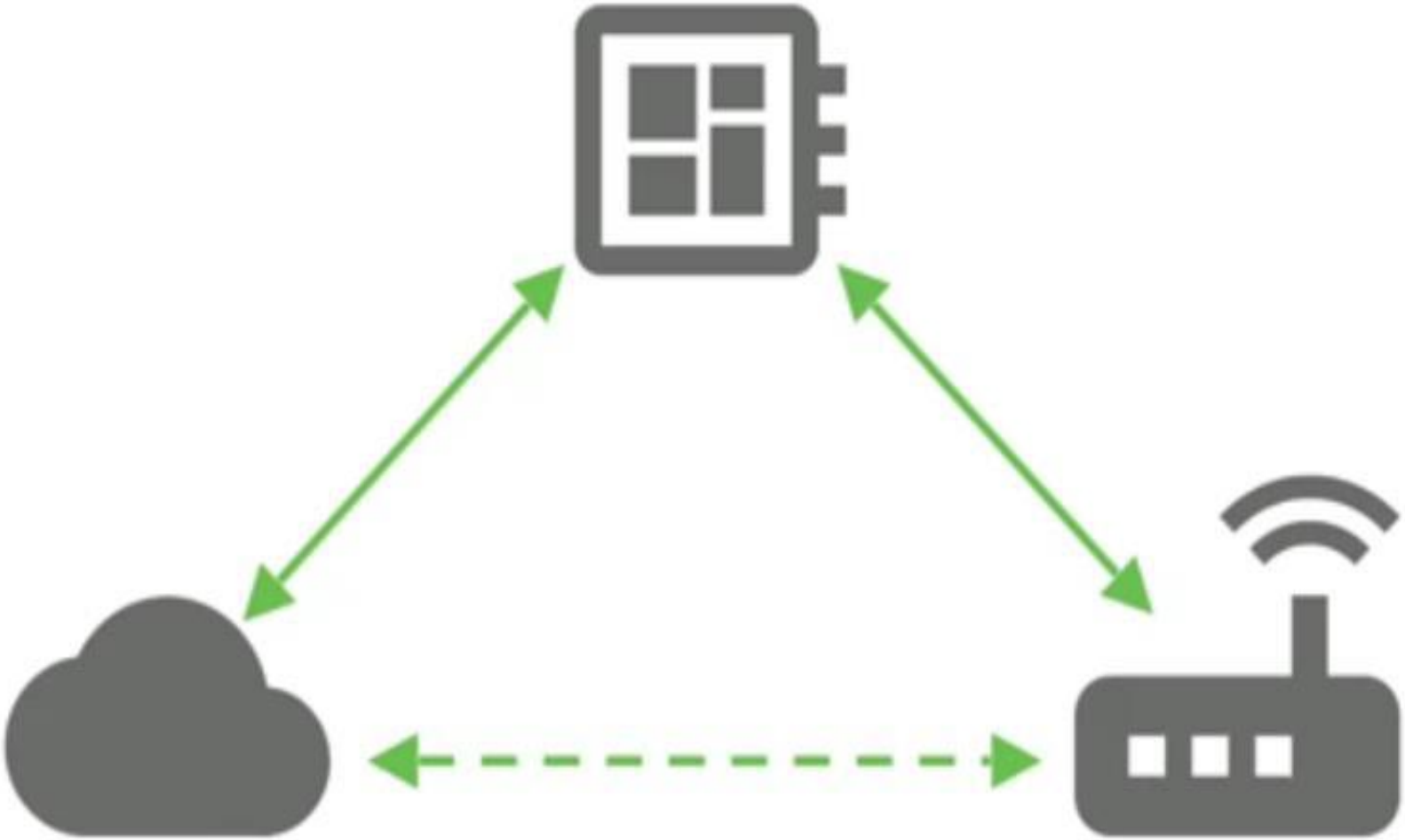
## (BUILD YOUR FIRST ANDROID THINGS DEVICE)

Emmanuel Obot

@emmanobot

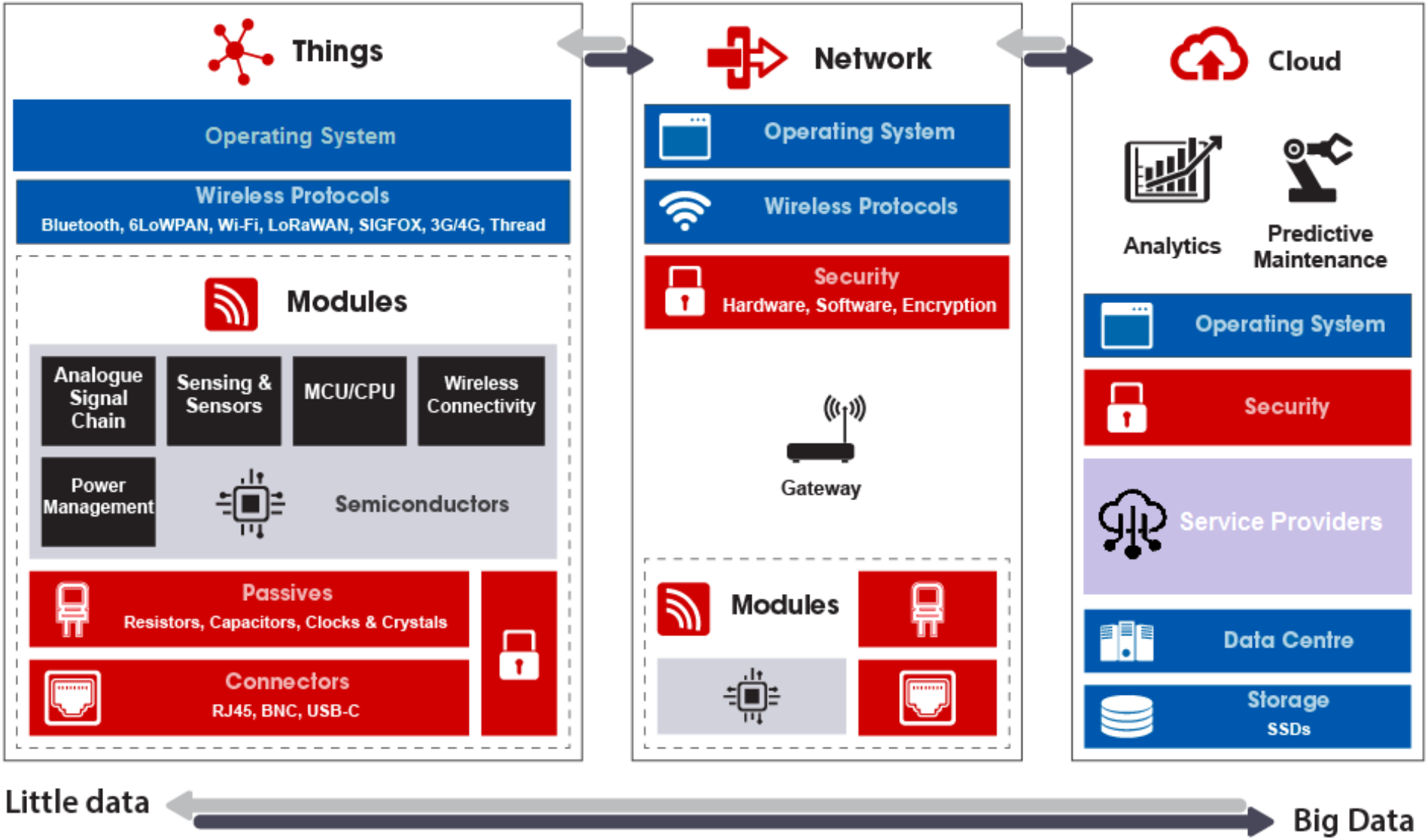
GDG Uyo

**Meetup**



# The Internet of Things

# Architecture of IoT



# Components of IoT

Sensors

Actuators

Virtual Objects

People

Services

Platforms

Network

# Idea for **powerful and Intelligence IoT** devices

- Automatic Street Lighting system
- Smart Building Project
- Smart Water Monitoring System
- Cloud-ready temperature sensor
- Temperature and Humidity Monitor
- Smart Irrigation System
- Intelligent Traffic Information System
- Smart Meters
- Smart Doorbells
- Multi Room Music Player
- Automatic Smart Parking System
- Home Automation
- Home Security Model
- Biometrics System
- Smart Home with Web Interface
- Wireless Sensor System
- Energy Monitors
- Asset Tracking
- Etc.

# Android Things


Intel® Edison

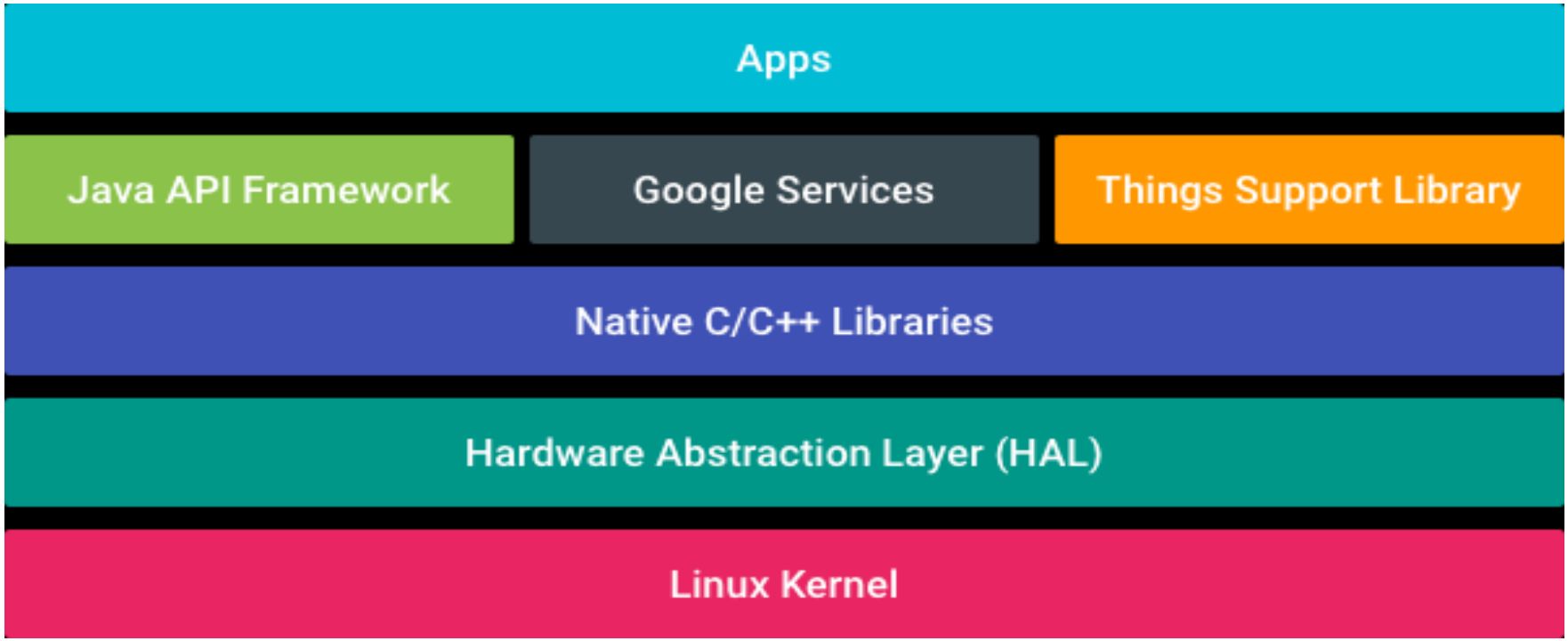
Raspberry Pi 3

android things

NXP Pico

**Android Things** is an extension of the **Android platform** for **IoT** and embedded devices.

# Android Things Overview




- ❑ Google Services
- ❑ API Level 7.0 (Nouget) +
- ❑ Things Support Library
  - Peripheral I/O API
  - User Driver API

- ❑ Graphics (optional)
- ❑ Home activity support
- ❑ Cloud IoT Core
- ❑ Permissions

# Platform Driving Android Things

Android SDK | Android Studio | Play Services | Firebase | Cloud Platform

# Google Cloud IoT Core

**Protocol Bridge**

**MQTT protocol** endpoint

Automatic load balancing

**Global data access** with Pub/Sub


**Device Manager**

Configure individual devices

Update and **control devices**

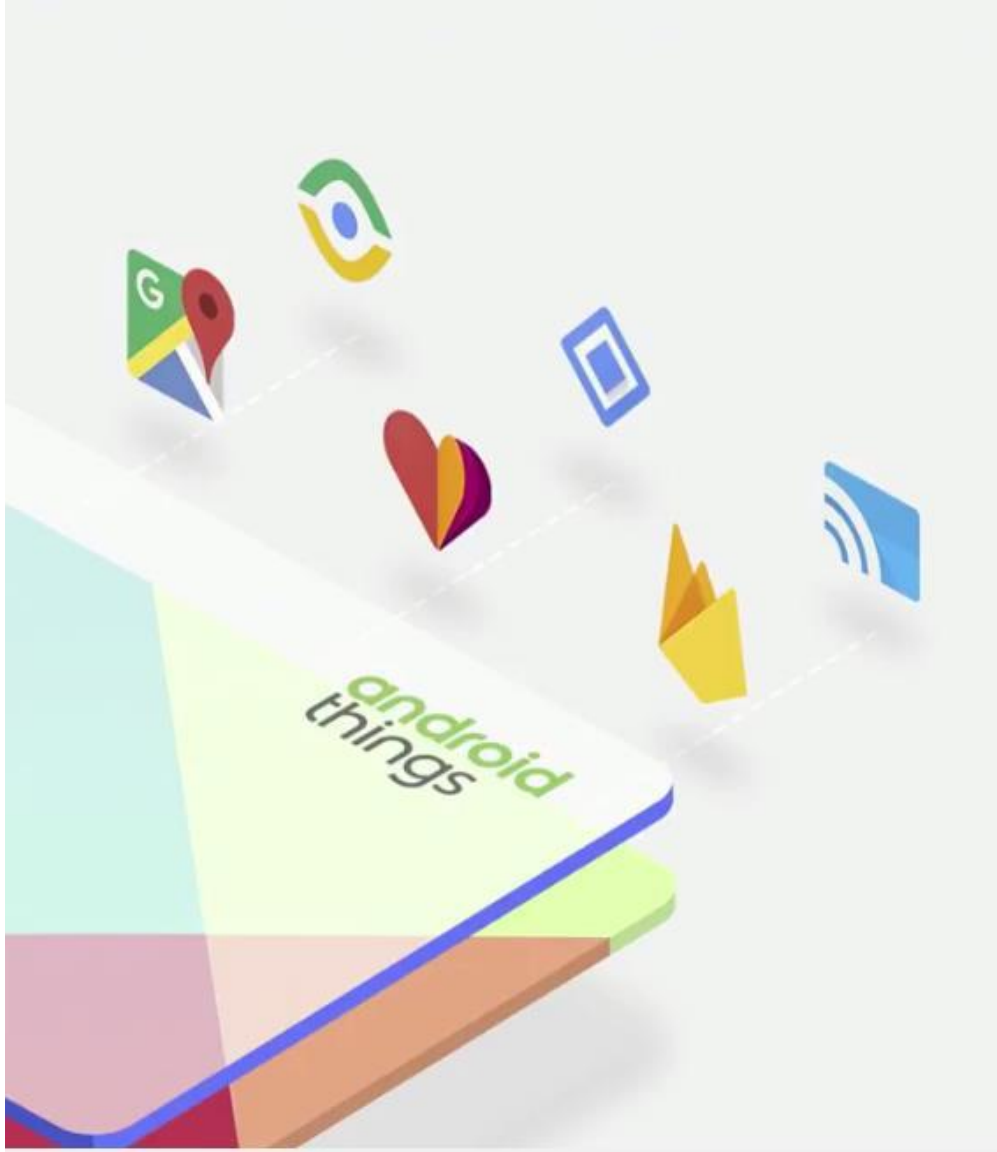
Role level access control

Console and APIs for device deployment and monitoring

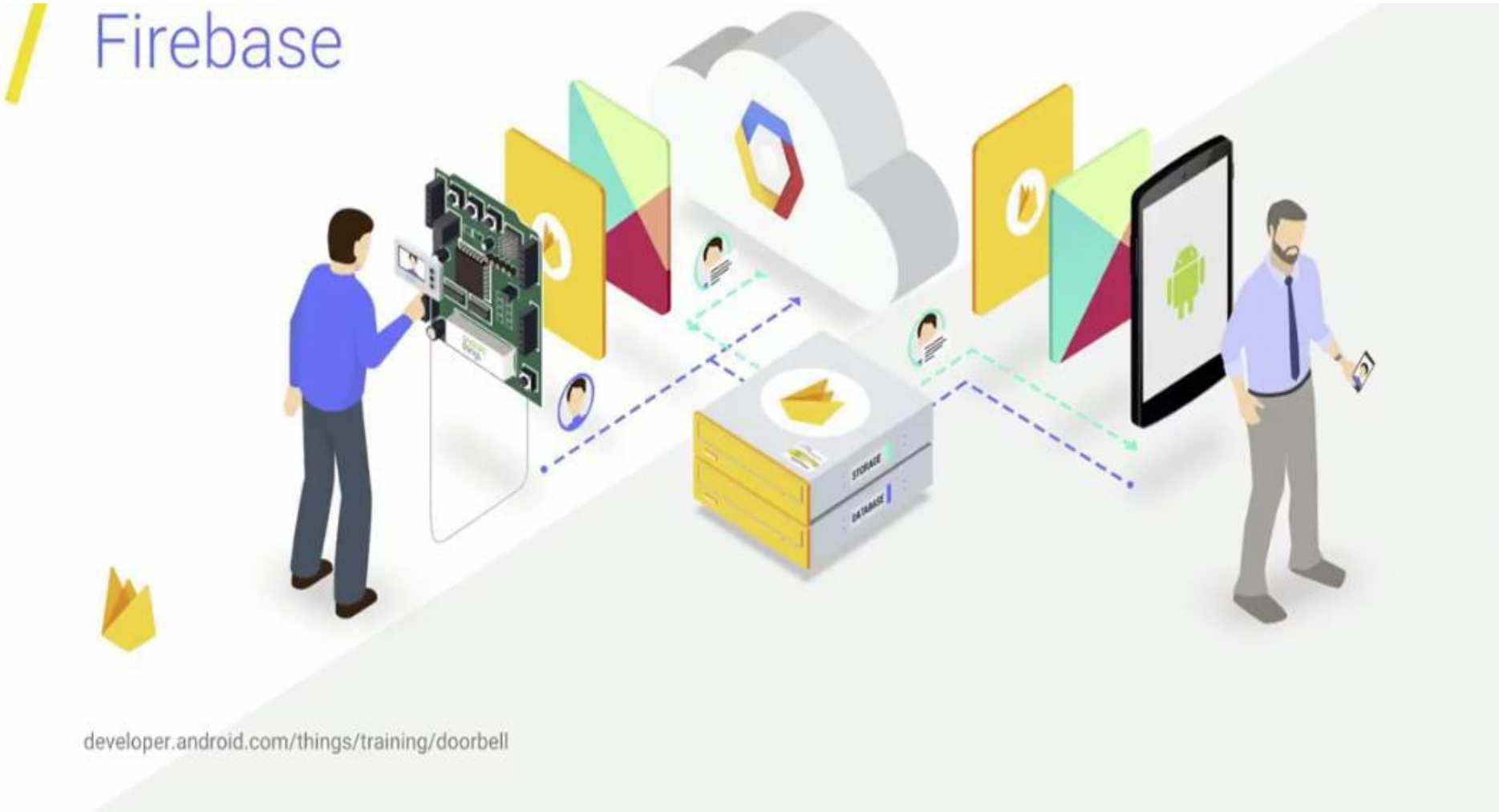
Allows you to easily and securely connect, manage, and ingest data from millions of globally dispersed devices.

# Google Play Services

Proprietary background service and API package for Android devices.



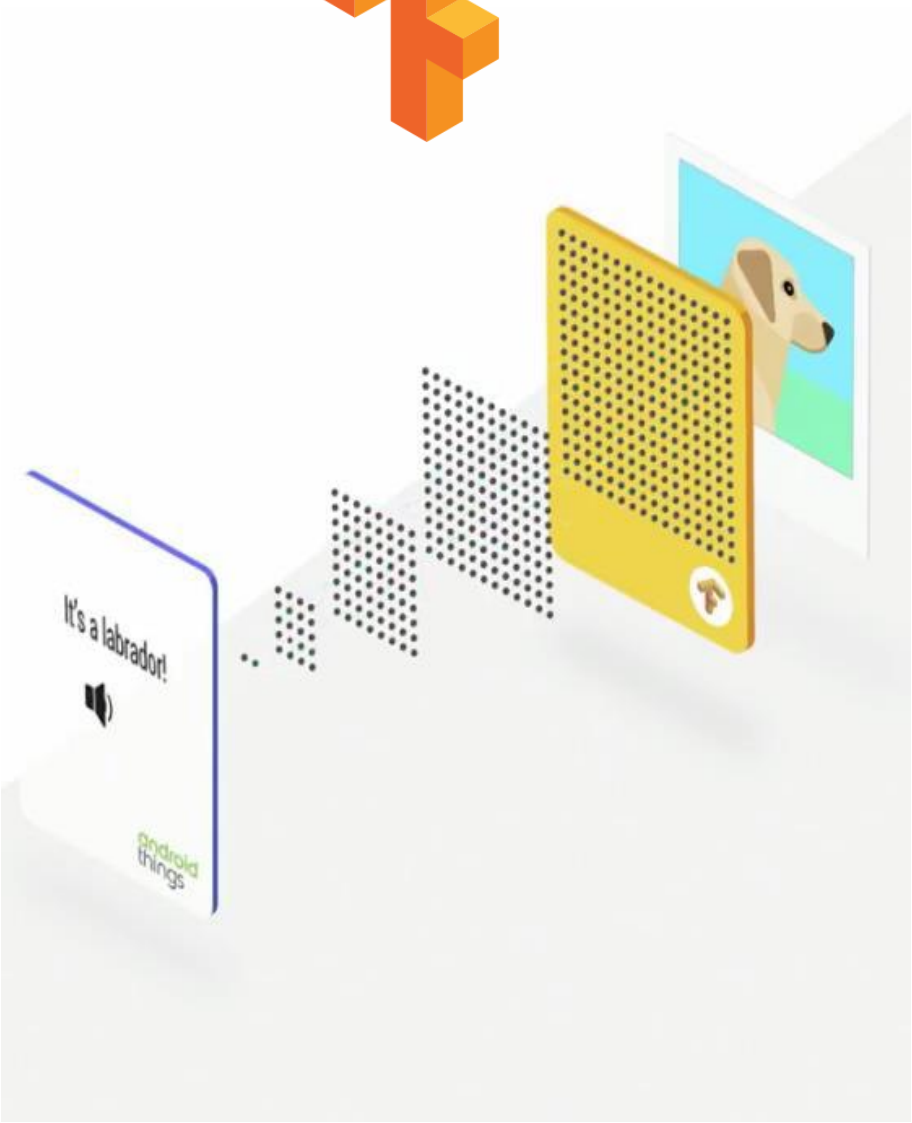
# Firebase




Analytics, databases, messaging and crash reporting

# TensorFlow

Add machine learning into Android Things apps.



# Why should it be Android Things?

The Power of Android

Managed by Google

Automatic and Secure

# android things

Google's IoT Developers Community
https://g.co/iotdev

Hackster.io Community
https://hackster.io/google

Google’s IoT Solutions
https://iot.google.com/

Android Things SDK
https://developer.android.com/things

Code Lab
https://codelabs.developers.google.com/?cat=IoT

# Building Android Things Device

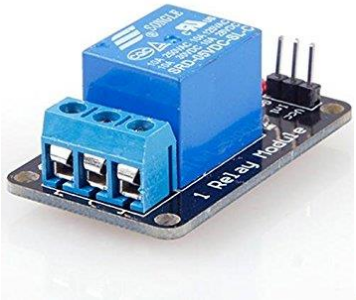
# Hardware (Developer Kits)

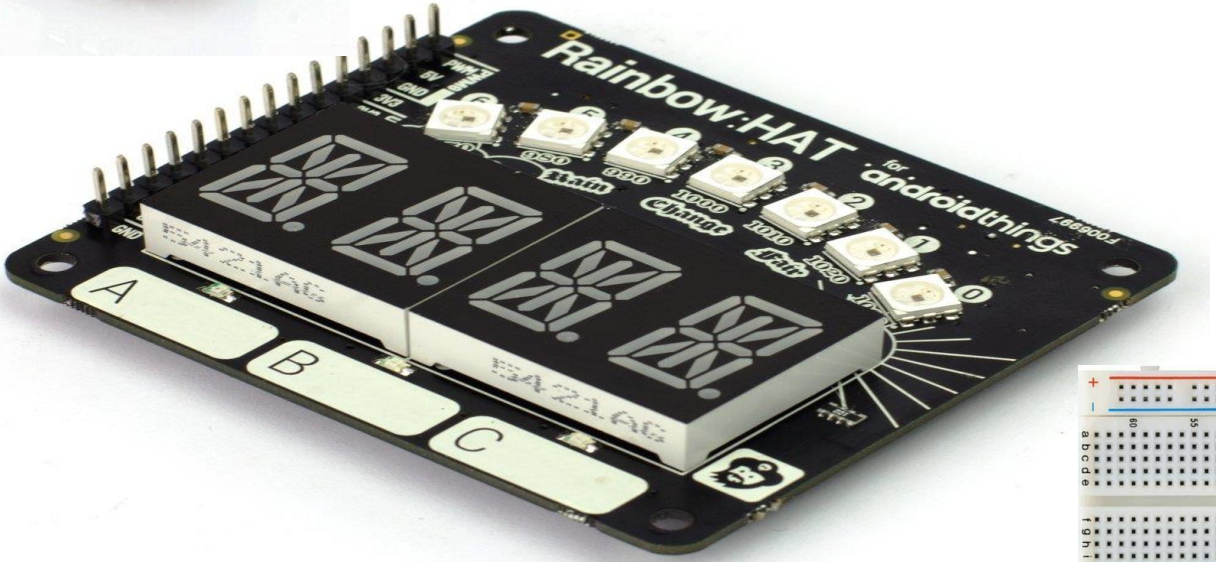
## Requirement 1: The Board (any one)

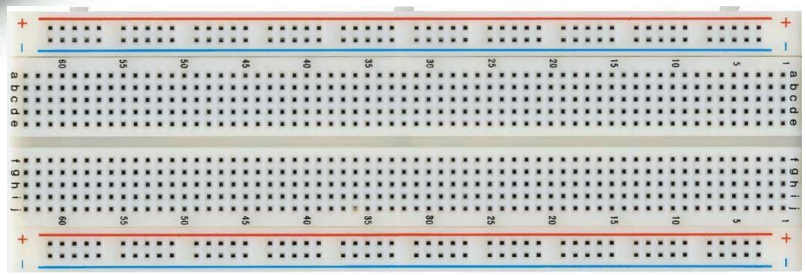
- NXP Pico i.MX7D (Recommended)
- NXP Pico i.MX6D
- Raspberry Pi 3
- Intel® Edison
- Intel® Joule

# Requirement 2: Peripherals

- LEDs + Buttons + Resistors + Breadboard + Jumper wires
- Or, a Rainbow Hat
- Relay
- Etc.



# Software (Android Things SDK)

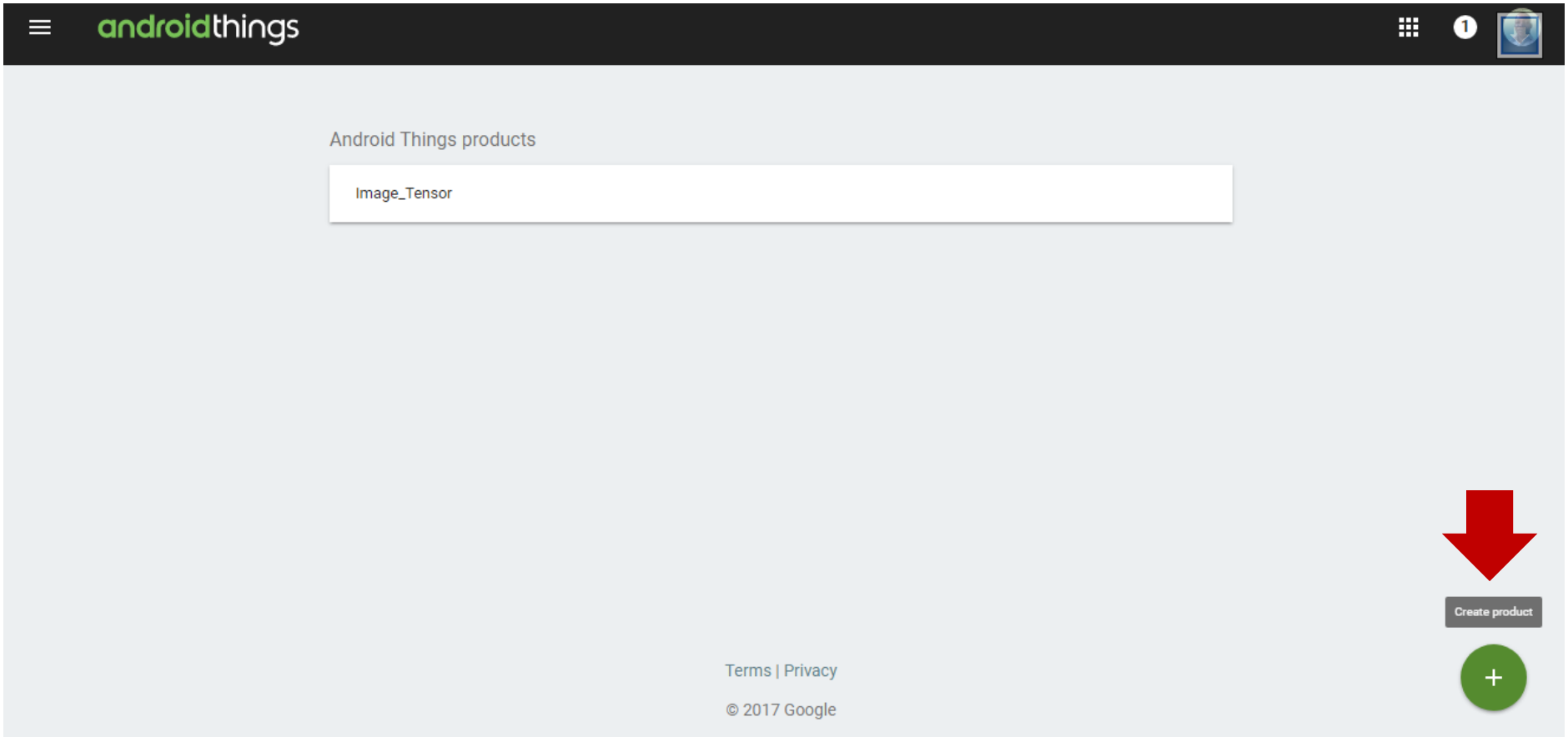
- Android Studio 3.0
- Android SDK Platform Tools (version 25.0.3 +)
- ADB tool command line terminal

# Flash Android Things Device

# Android Things Console

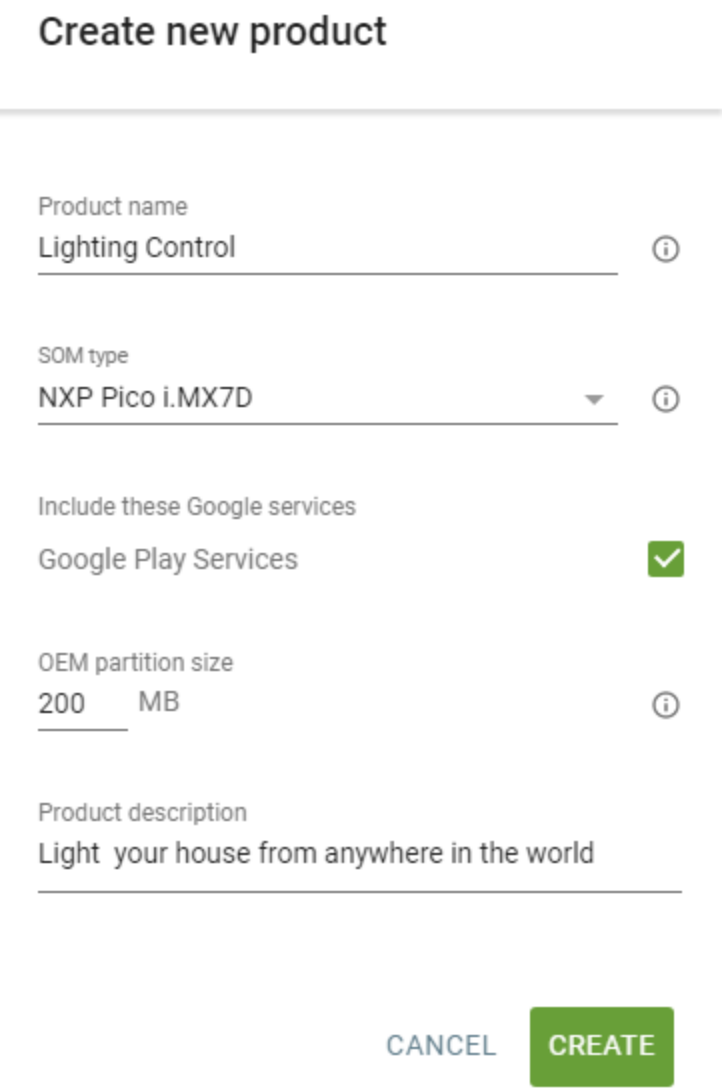
Go to “Android Things Console” and follow the step below to download the latest preview image for your  Android Things board.

# Create a New Product

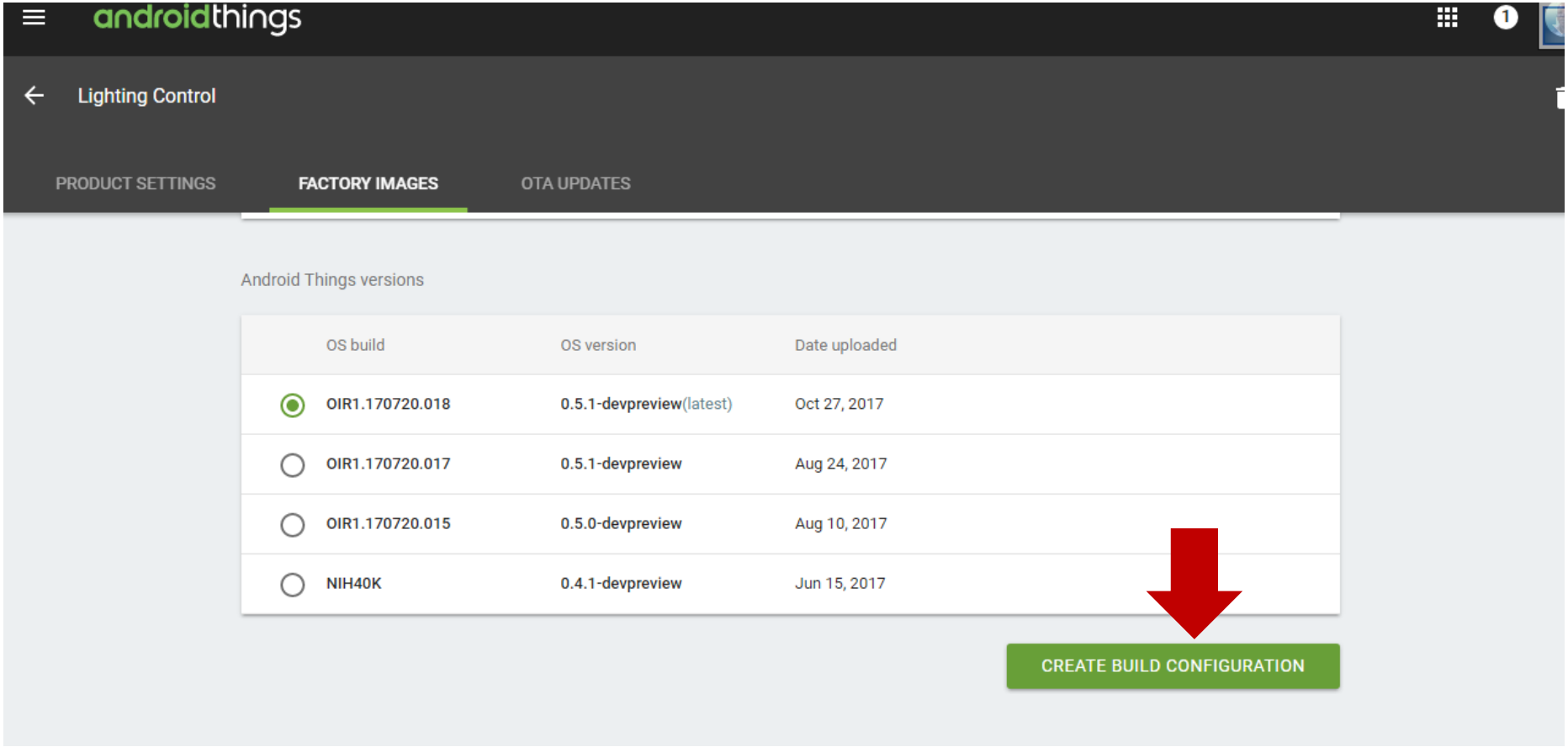


# Create new product

- Enter your product name
- Select your board
- Set OEM partition size (must be between 32 and 512 MB)
- Describe Your product and
- Click Create



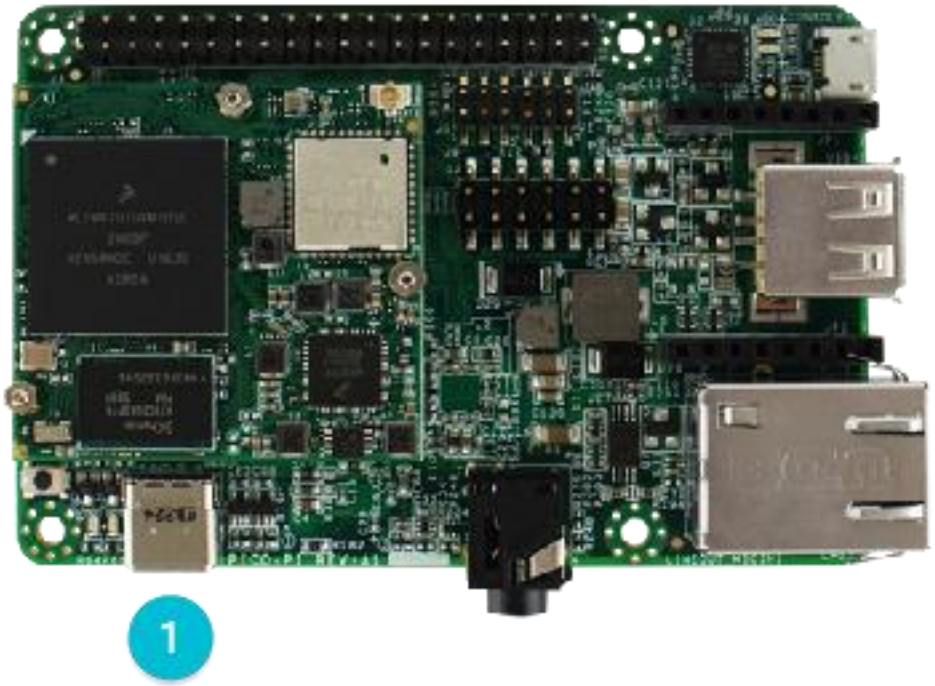
# Create new factory image




**Download the factory image to your system.**

Unzip the image and copy all the files in the image folder to directory ...Android/sdk/Platform-tools

# Connect the Board



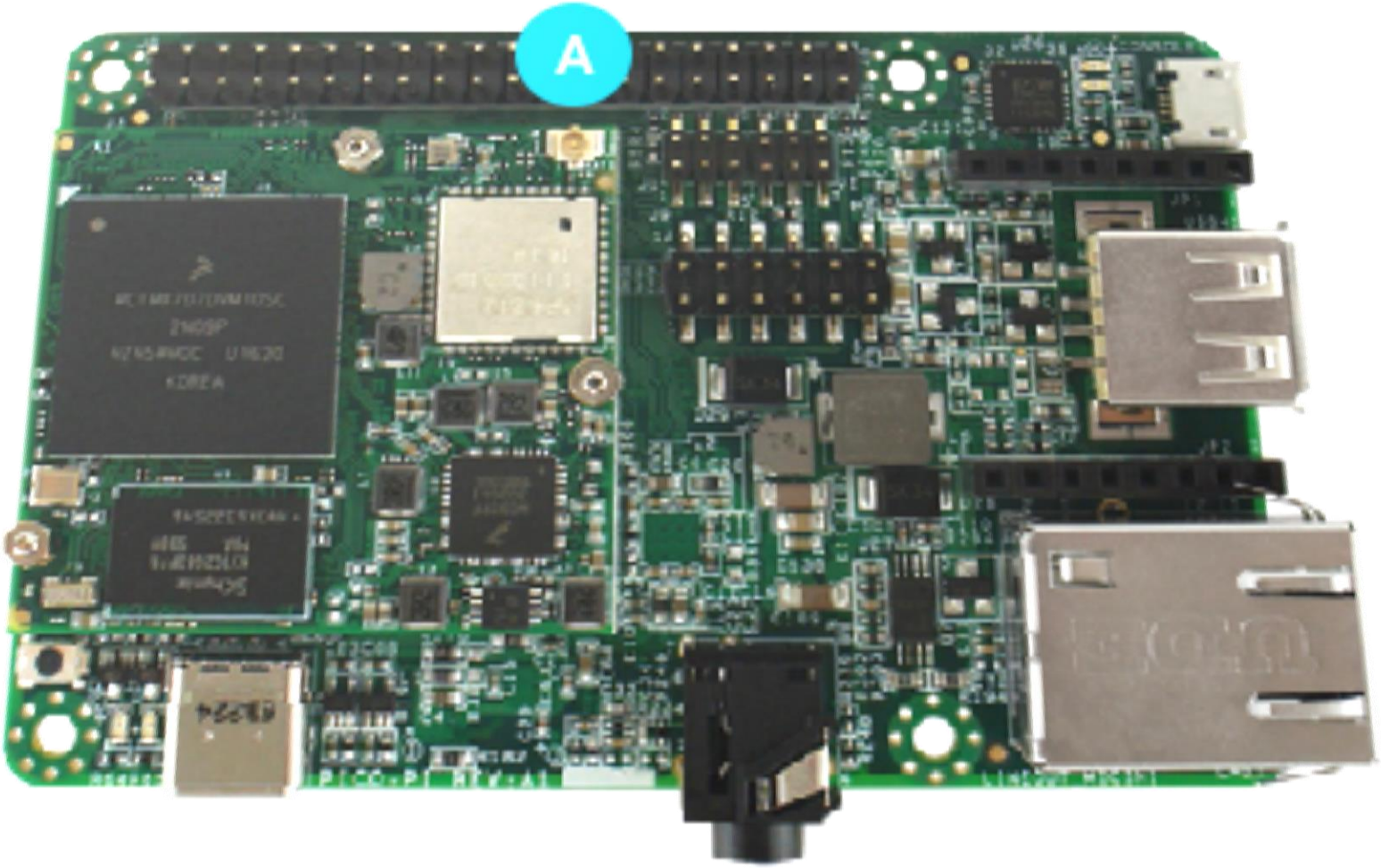

Connect a USB-C cable  (Label 1) from host computer for Power and USB OTG

# Flash Android Things

- Open a command line terminal (in Android Studio) and navigate to the unzipped image directory ...Android/sdk/Platform-tools (adb tool)
- Verify that the device has booted into Fastboot mode by executing the following command: "***adb fastboot devices***" || reply: 1b2f21d4e1fe0129 fastboot
- Your device will not boot into Fastboot mode if it was previously flashed with Android Things, execute the following command to reboot the device into Fastboot mode. "***adb reboot bootloader***"
- Execute the ***"flash-all.bat"*** and the device automatically reboots into Android Things when the process is complete
- To verify that Android is running on the device, execute the command: "***adb devices***" || reply: List of devices attached 1b2f21d4e1fe0129 device

# Connecting Android Things device to Wi-Fi

Before connecting the board to a Wi-Fi network, attach an external IPEX or u.FL Wi-Fi antenna to the board as shown



# To connect your board to Wi-Fi

- Open Android Studio terminal and navigate to "..sdk/platform-tools" to access adb tool and run the following ADB command with your WiFi SSID (wifi network name) and WiFi Password (alternatively connect an ethernet cable): ***"adb shell am startservice –n com.google.wifisetup/.WifiSetupService -a WifiSetupService.Connect -e ssid YourWifiSSID -e passphrase YourWifiPassword"***

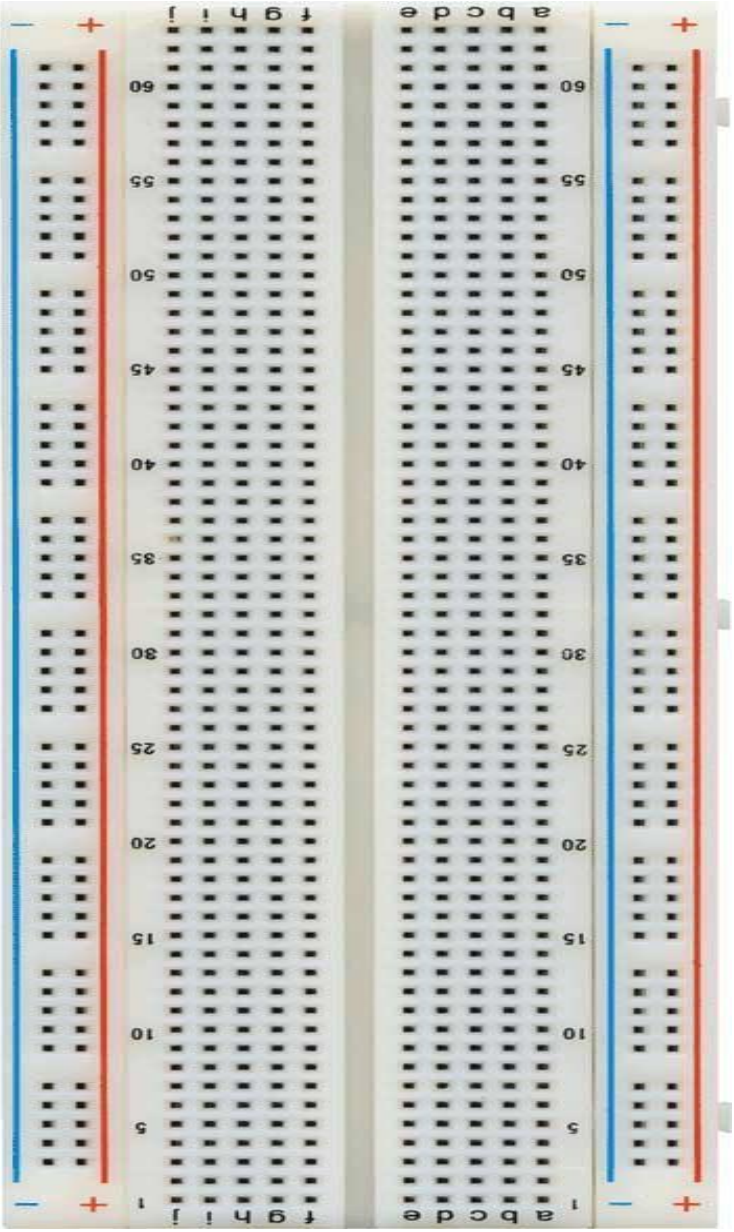
- To verify that the connection was successful through logcat, use the command: "***adb logcat -d***"

- To test that you can access a remote IP address use the command: "***ping 8.8.8.8***".

# Basic Electronics

# Breadboards

- A common tool for quickly prototyping circuits without soldering components together.
- Each row (horizontal) of 5 holes are connected.
- Vertical columns – called power bus ($V_{CC}$ and GND) are connected vertically



# Power supply

Power is the input voltage delivered to the components on the board from an external source such as a wall adapter, battery, or USB port.

The following signals are provided to the board via power supply:

- $V_{IN}$ - Voltage of external source connected to the board
- $V_{CC}$ or $V_{DD}$ - Internal regulated voltage powering the components on the board (+5V, +3V, and +1.8V).
- Ground (GND) - Reference point for 0 volts on the board.

To shut down a board, disconnect the power supply.

# Analog and Digital I/O

**Input/output**

- **Input** pins allow your device app to read and interpret the current electrical state.
- **Output** pins allow your device app to control the electrical state of the pins.

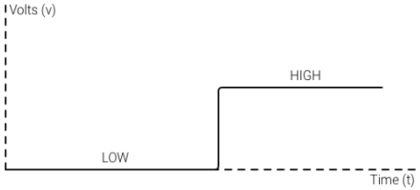
**Analog**

- Analog signals are signal that can be a full range of values , example is a temperature sensor.
- Analog inputs translate a discrete voltage level into a proportional integer value using an analog-to-digital converter (ADB).

**Digital**

Digital logic represents a voltage signal as a binary value:

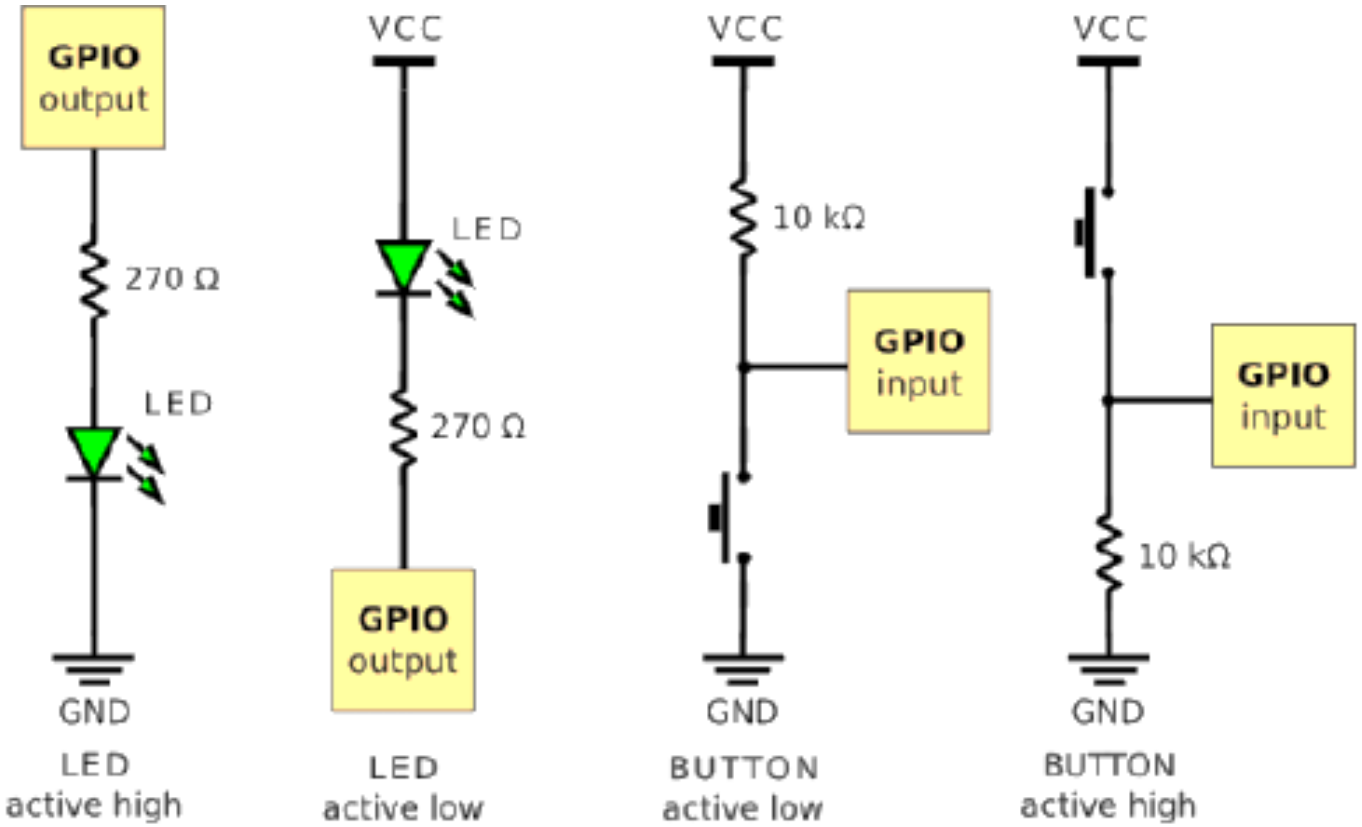
- **High**: When the voltage is at or near VCC. Represented as a logical "1".
- **Low**: When the voltage is at or near ground. Represented as a logical "0".



# Android of Things Supported Peripherals

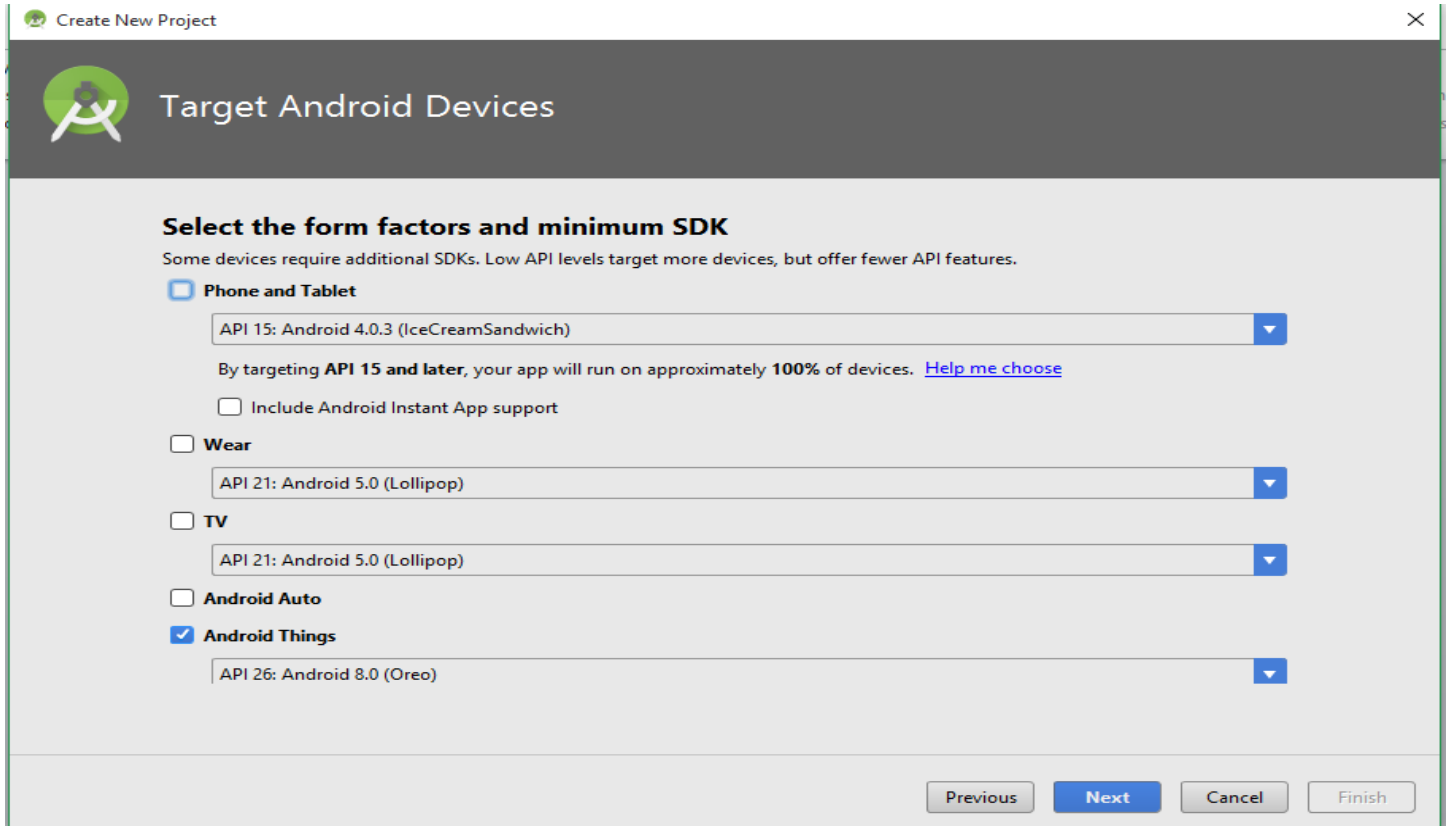
- GPIO  - General Purpose Inputs/Outputs
- PWM - Digital to Analog Output
- Serial Communication
  - I2C (synchronous , 2 wires, up to 127 peripherals, low speed)
  - SPI (synchronous , 4+ wires, unlimited peripherals, high speed)
  - UART (asynchronous, 2 or 4 , only 1 peripheral, medium speed)

# GPIO: Input and Output



# Create Android Things Project in Android Studio

# Create your app project using the new project wizard




- ❑ Select Android Things as the form factor
- ❑ In order to access new APIs for Things, target Android 8.0 (Oreo), API level 26 or higher
- ❑ Name the new empty activity HomeActivity

# Add Library

The new project wizard automatically adds a dependency to the support library to your app-level build.gradle file

```
dependencies{
    ...
    compileOnly 'com.google.android.things:androidthings:+'
}
```

The wizard will also adds <uses-library android:name="com.google.android.things"/> to your app's manifest file to make this prebuilt library available to the app's classpath at run time

# Add Default Home Activity

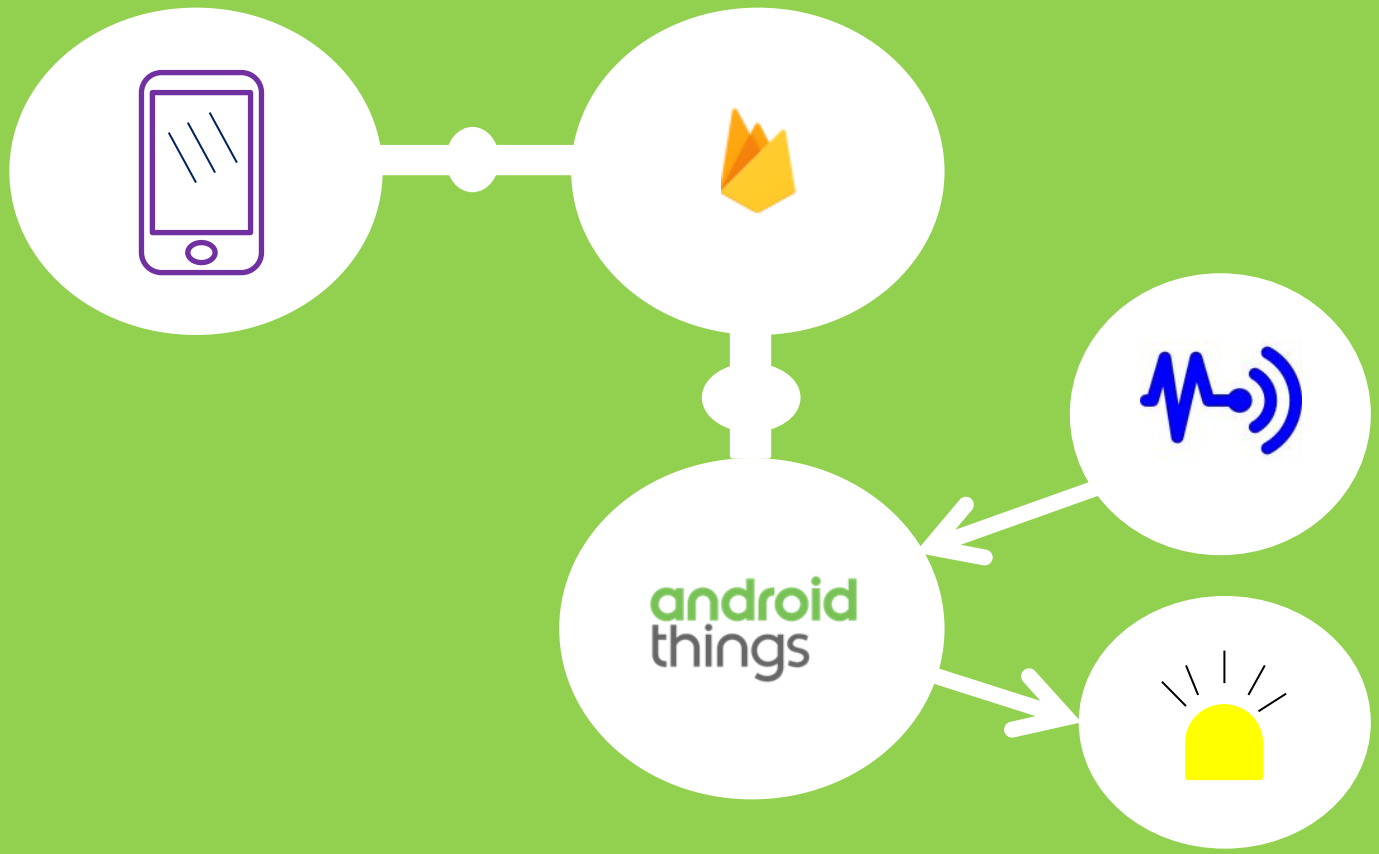
Declare an activity in the manifest as the main entry point after the device boots

```
<application>
    <uses-library android:name="com.google.android.things"/>
    <activity android:name=".HomeActivity">
        <!-- Launch activity as default from Android Studio -->
        <intent-filter>
            <action android:name="android.intent.action.MAIN"/>
            <category android:name="android.intent.category.LAUNCHER"/>
        </intent-filter>

        <!-- Launch activity automatically on boot -->
        <intent-filter>
            <action android:name="android.intent.action.MAIN"/>
            <category android:name="android.intent.category.IOT_LAUNCHER"/>
            <category android:name="android.intent.category.DEFAULT"/>
        </intent-filter>
    </activity>
</application>
```

# Demo Project

# Home automation and monitor with Android Things and Firebase



# Project Description

Android things base project to remotely control appliances and monitor movement via mobile phone with notification.

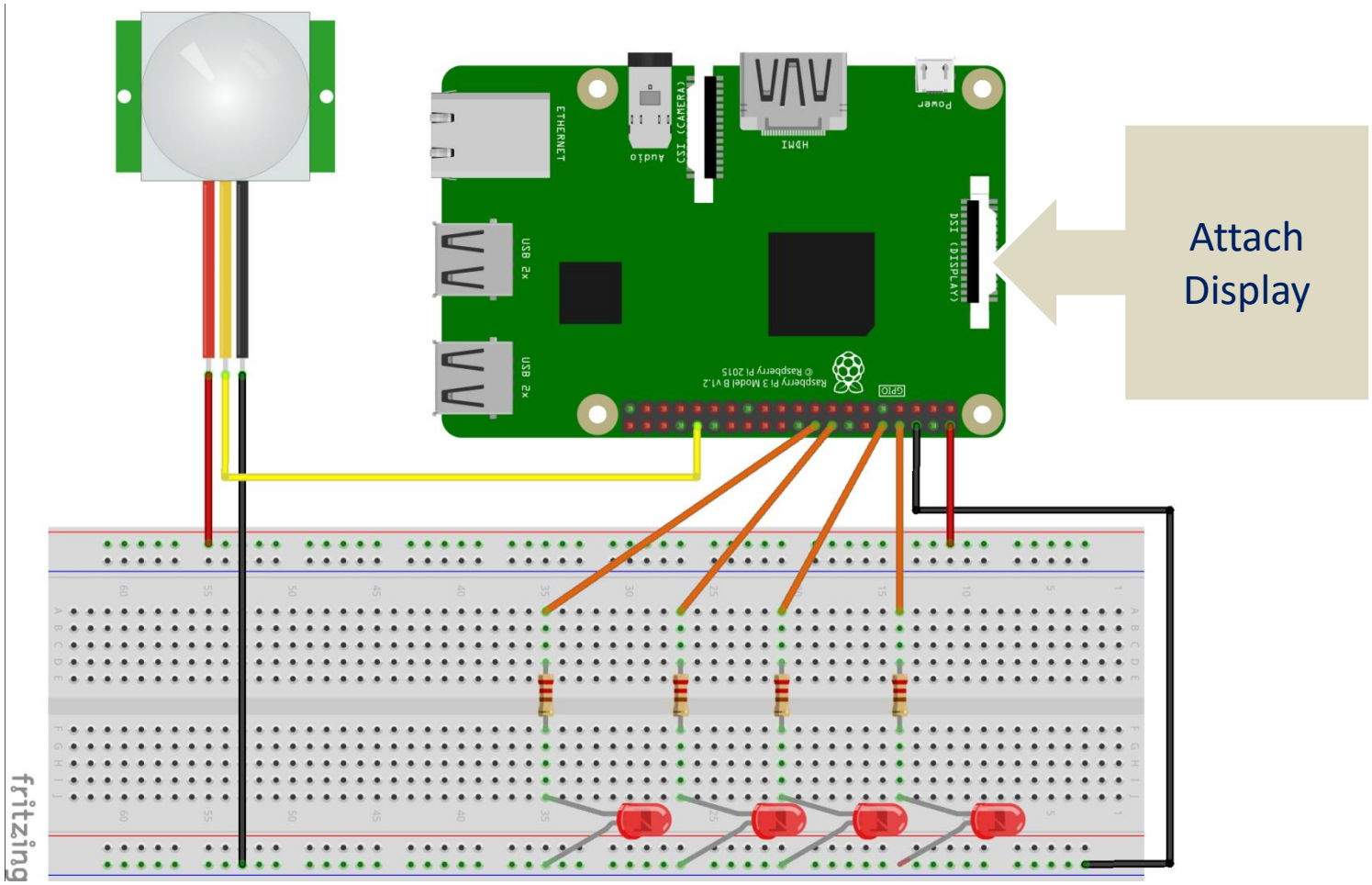
Things to be use in this project

- Hardware components:

| | |
|---|---|
| NXP Pico i.MX7D | x 1 |
| LED | x 4 |
| Resistor 220R | x 4 |
| Breadboard | x 1 |
| Jumper wires | x 10 |
| TechNexion 5 inch Multitouch Display | x 1 |
| 4 channel Relay Board | x 1 |
| PIR Motion Sensor | x 1 |

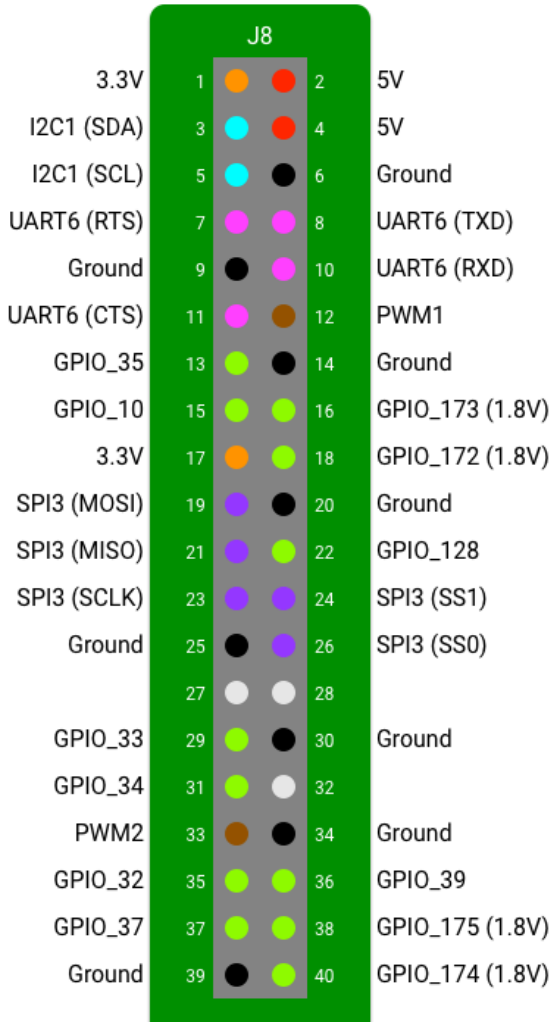
- Android device
- Google Android Studio
- Online Service (Firebase)
- Internet

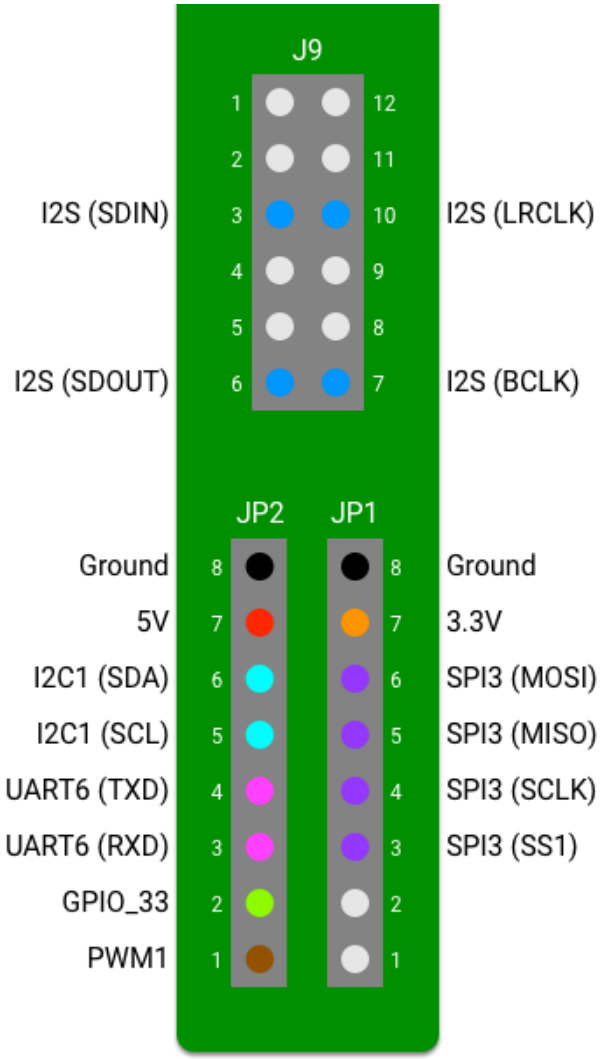
# Breadboard Diagram



# Pico i.MX7D Peripheral I/O

= 5V = 1.8V = GPIO = I2C = SPI
= 3.3V = Ground = PWM = I2S = UART



# Connect the Hardware

- Connect ground pin from the board to the breadboard (pin 39).
- Connect the chosen GPIO output pin to one side of a series resistor
  - GPIO_32 (Pin 35)
  - GPIO_33 (Pin 29)
  - GPIO_34 (Pin 31)
  - GPIO_37 (Pin  37)
- Connect the other side of the resistor to the anode side (longer lead) of the LED or Relay.
- Connect the cathode side (shorter lead) of the LED to ground row on the breadboard.
- Connect the PIR motion sensor to GPIO_10 (Pin 15)

# Set up the Project

Download or clone demo project from https://github.com/emotexplanet/Home-Automation-With-Firebase.

The repository consists of 2 project:

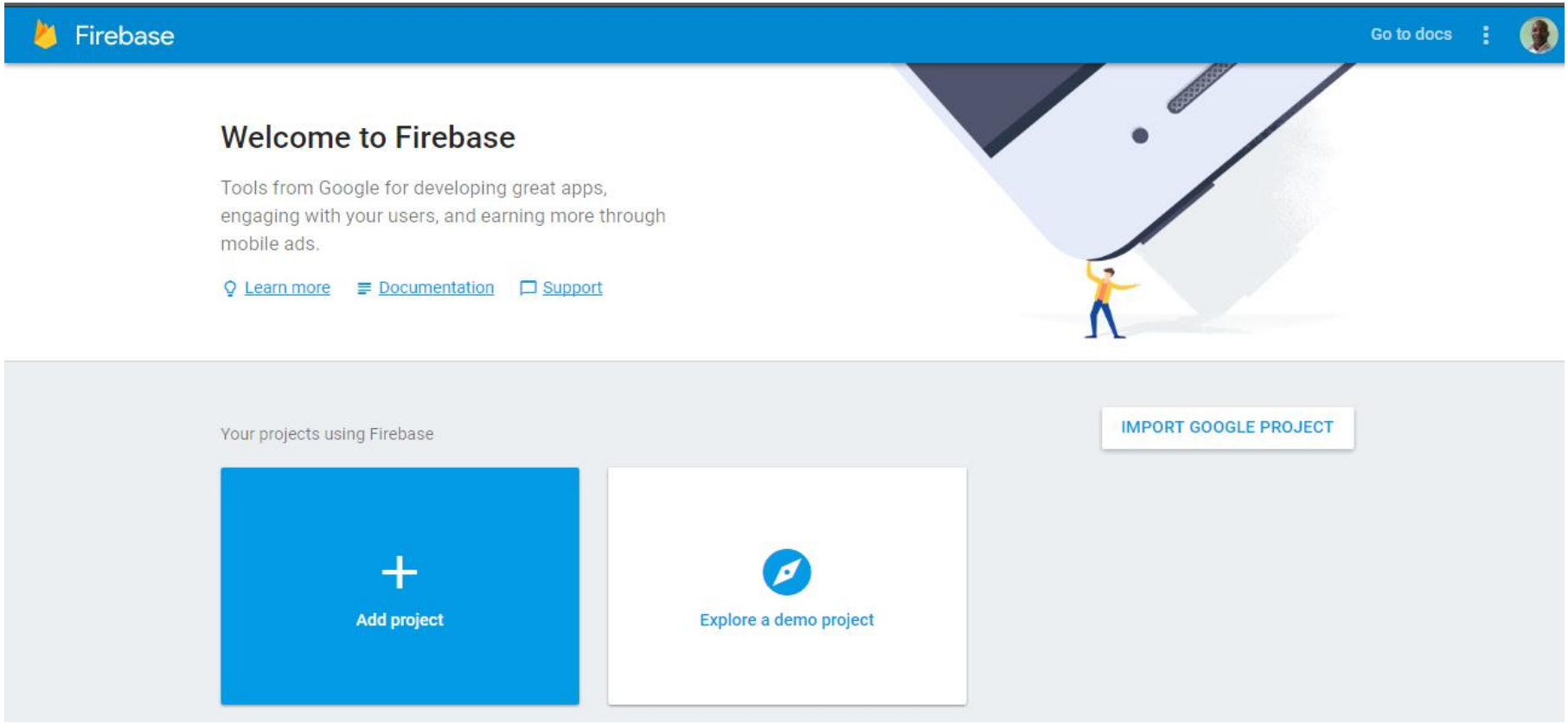
- Mobile: the companion app that runs on android phone. It has four switches to turn individual light on and off, as well as two buttons, one to turn all the lights on and one button to turn all the lights off. And a field to monitor remote movement.

- Things: the project runs on Android Things device to control the electrical appliances through the Peripheral I/O GPIO API and also display the status of each device on the screen.

Add Firebase Realtime database to the project: this is used to store and retrieve the state of devices from mobile phone and Android Things device will also retrieve the data to control your light.

# Create a Firebase Project

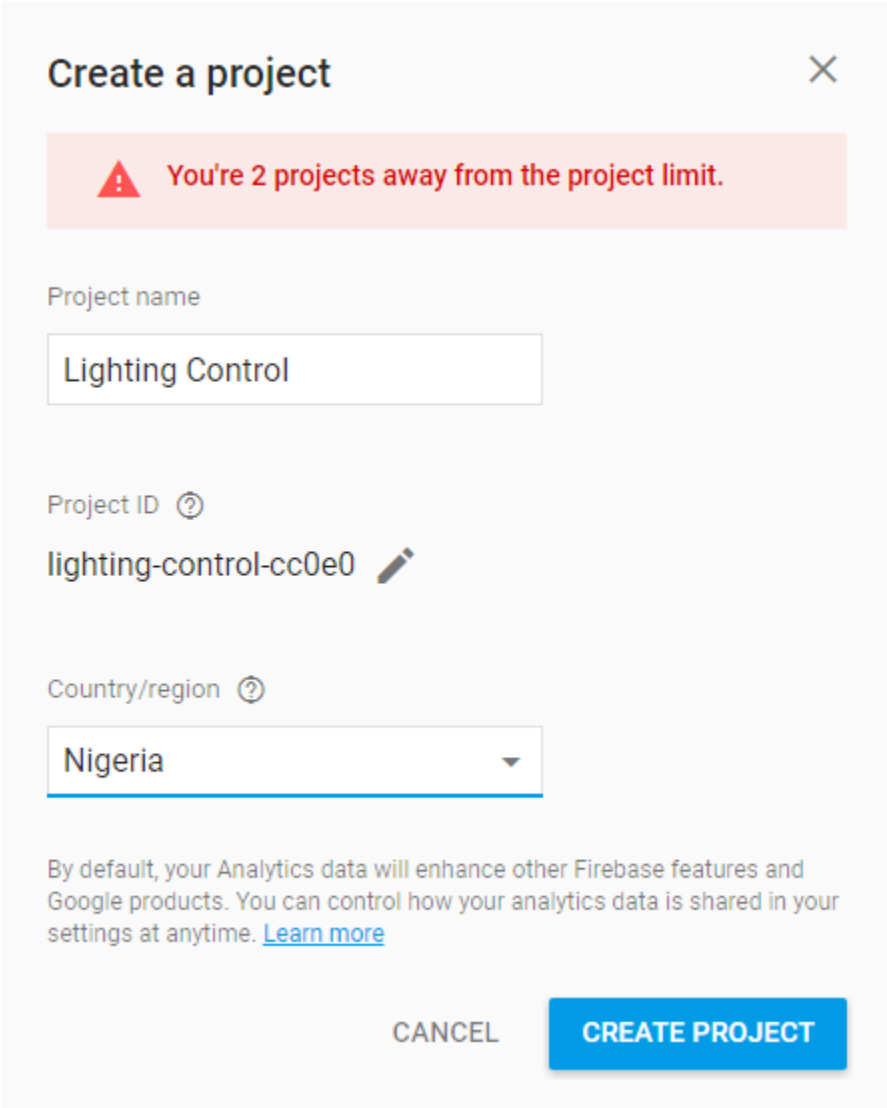
Go to firebase.google.com or visit firebase.google.com/docs/android/setup



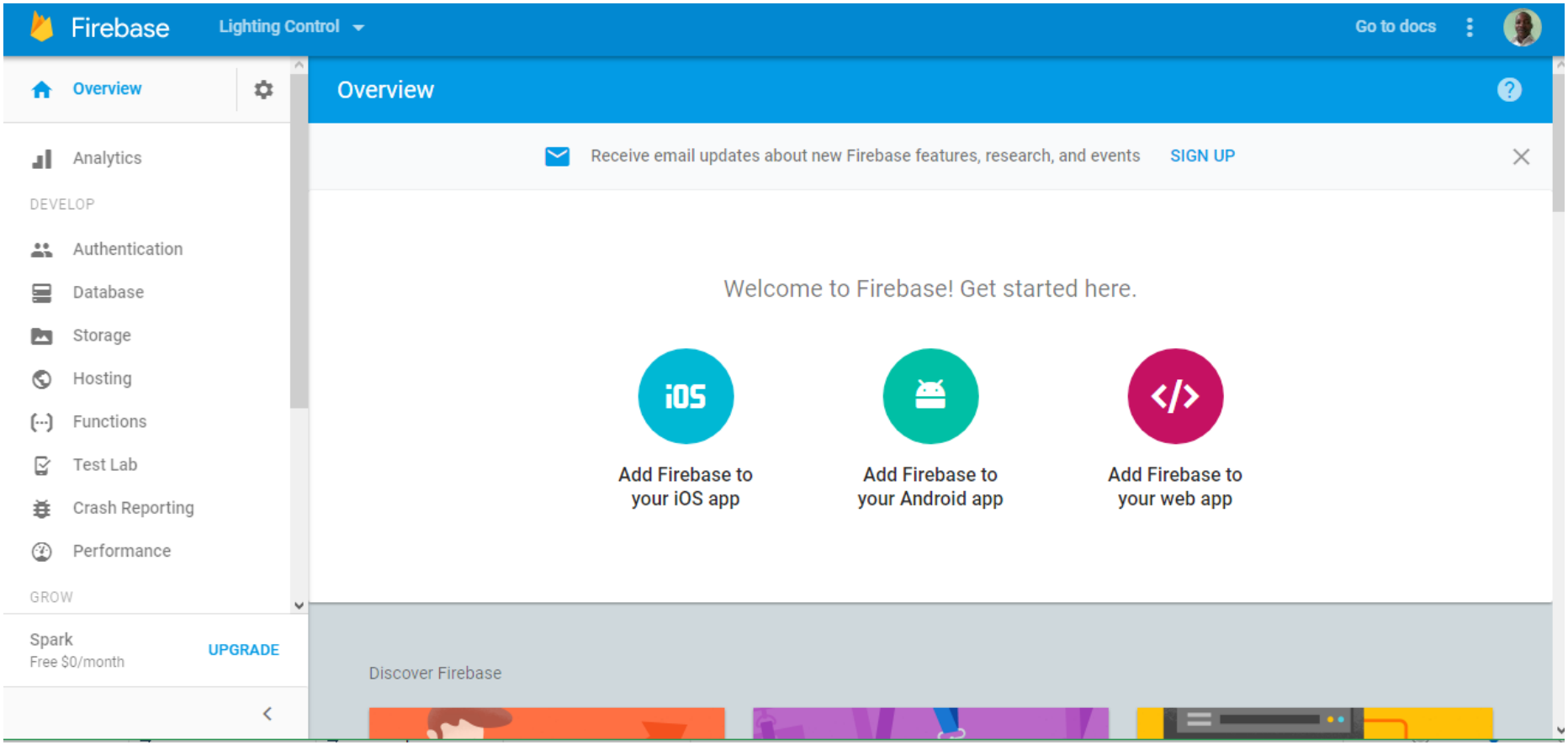

Click "**Add project**"

# Create a Project

- ❑ Enter project name
- ❑ Select a region
- ❑ Click “**Create Project**”

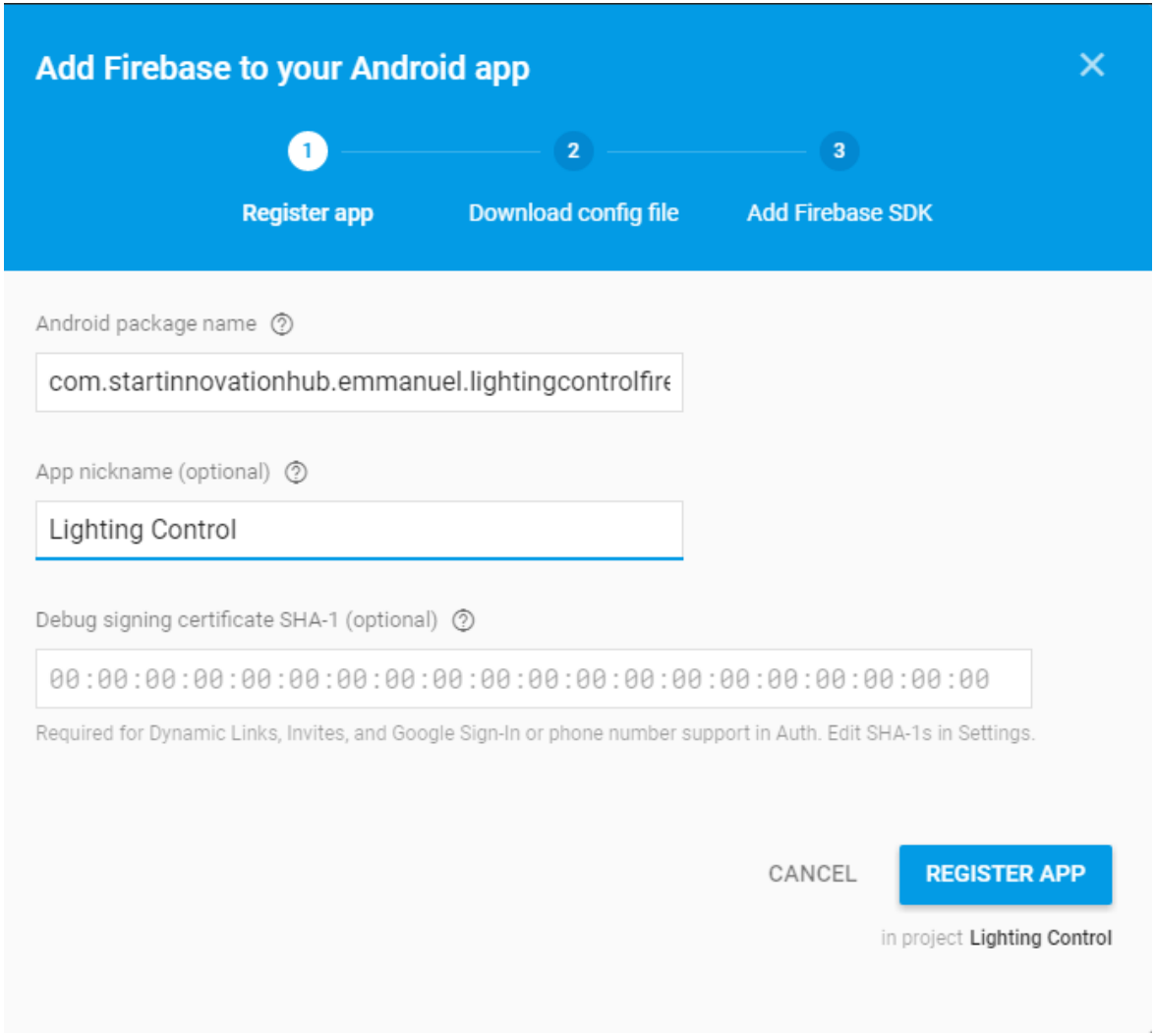


# Add Firebase to Project




Click “**Add Firebase to your Android App**”

# Enter the Package Name

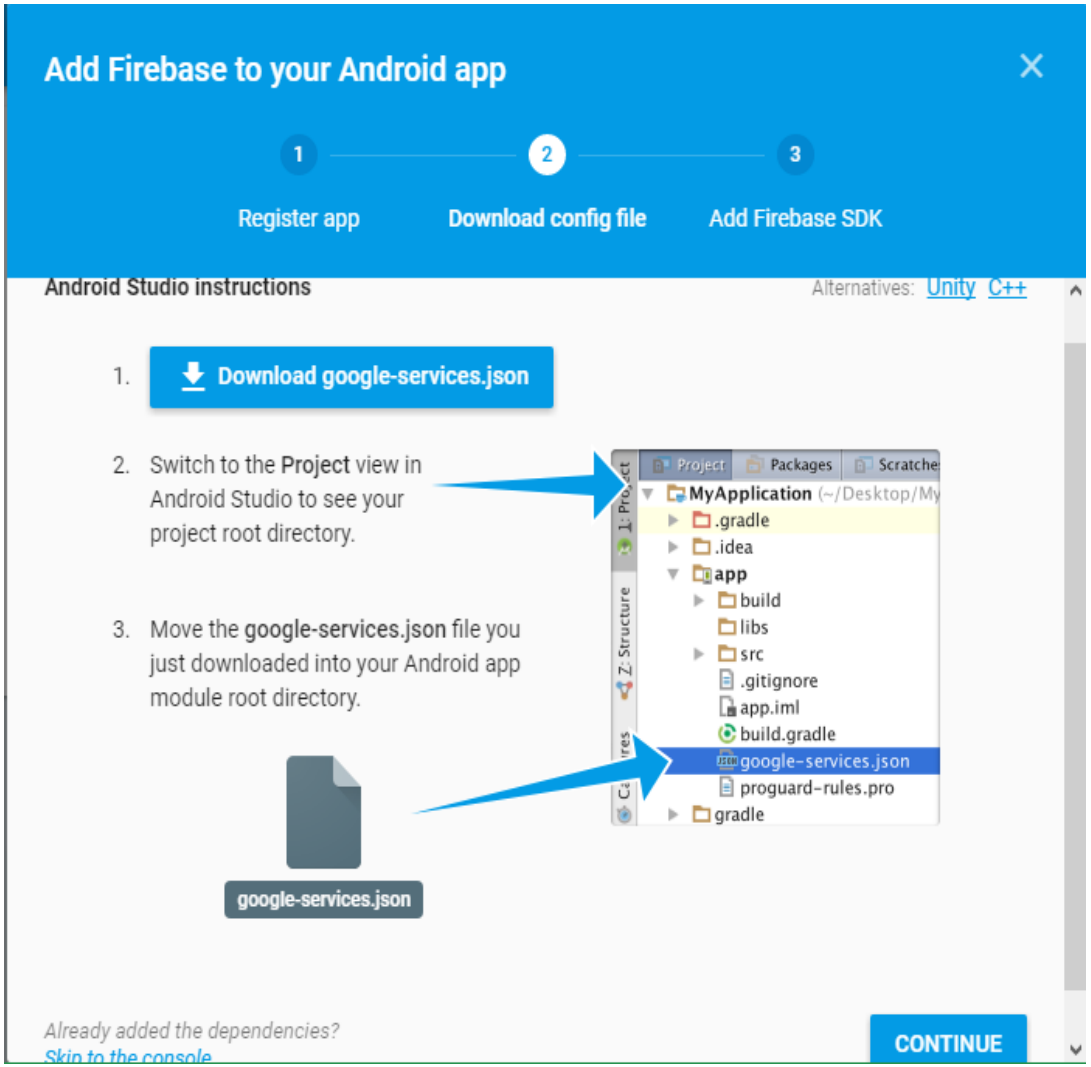



Click “**REGISTER APP**”

# Download Google-Services.json

Save the file into project's module folder:

- ✓ Home-Automation-With-Firebase\mobile\google-services.json
- ✓ Home-Automation-With-Firebase\things\google-services.json




Click "**Continue**"

# Add the Classpath and Plugin to Gradle Files

## Add Firebase to your Android app

1 Register app — 2 Download config file — 3 Add Firebase SDK

**Gradle instructions**

Alternatives: Unity C++

The Google services plugin for Gradle loads the `google-services.json` file you just downloaded. Modify your build.gradle files to use the plugin.

1. **Project-level build.gradle** (`<project>/build.gradle`):

```
buildscript {
  dependencies {
    // Add this line
    classpath 'com.google.gms:google-services:3.1.0'
  }
}
```

2. **App-level build.gradle** (`<project>/<app-module>/build.gradle`):

```
...
// Add to the bottom of the file
apply plugin: 'com.google.gms.google-services'
```

*includes Analytics by default*

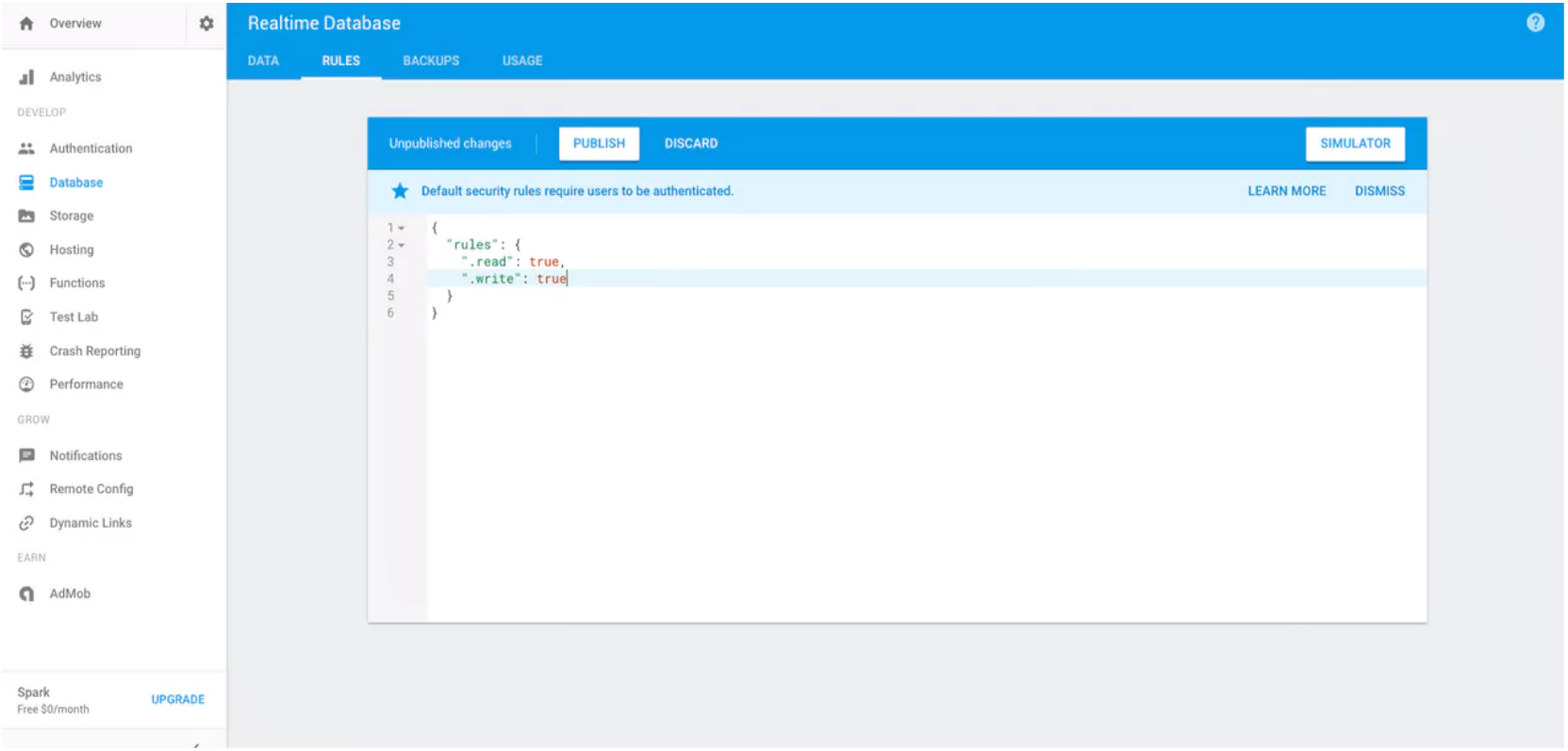
3. Finally, press "**Sync now**" in the bar that appears in the IDE:

# Add Firebase Realtime Database Dependency to App-level build.gradle file

```
dependencies {
    ...

    compile 'com.google.firebase:firebase-core:11.0.1'
    compile 'com.google.firebase:firebase-database:11.0.1'
}
```

# Configure Database Rules




Click on **"Database"** and select **"Rules".** Change "**read**" and "**write**" to return true. Click "**Publish**"

# About the Project

Android Things project contain the follow source files:

- PinSetting; this class is used to control the devices.
- DeviceStatusEventListener: this class observed the firebase DataSnapshot and make changes to the device base on the value in the DataSnapshot.
- NotificationManager; for sending notification when movement is detected.
- MainActivityThings: Main activity of the application.

Android Things support library  is included in the app-level build.gradle file to enable access to the Peripheral I/O API.

```
dependencies {
        compileOnly
'com.google.android.things:androidthings:+‘
}
```

Android mobile project contain the follow source files:

- SwitchChangeEventListener: this class observed the status of the switches as well as the buttons and upload their value in boolean form to firebase database.
- MonitorChangeEventListener: this class observed the firebase DataSnapshot and display base on the value in the DataSnapshot.
- MainActivityMobile: Main activity of the application.
- NotificationService: for remote movement notification.

To communicate with firebase database: Firebase Realtime Database Dependency should be added to the two project.

```
dependencies {
    ...
    compile 'com.google.firebase:firebase-core:11.0.1'
    compile 'com.google.firebase:firebase-database:11.0.1'
}
```

# Deployment of Both Things and Mobile Apps

**In Android Studio**

For Android things:

- Select "**things**" module
- Click run button
- Select Android Things Device to deploy the "**things**" module
- Click "**OK**"

For Android phone companion App:

- Select "**mobile**" module
- Click run button
- Select the mobile phone
- Click "**OK**"

# Links and Resources

- https://github.com/emotexplanet/Home-Automation-With-Firebase (Demo Project)
- https://firebase.google.com/docs/android/setup
- https://developer.android.com/things/training/doorbell/firebase-db.html
- https://developer.android.com/things/hardware/imx7d-pico-io.html
- https://developer.android.com/things/hardware/imx7d.html