Building Simple & Low-cost IoT Display

29.08.2023 - Birkan Kolcu

Overview

- What does Simple IoT Display Look Like?
- Is it Really Cheap?
- Why?
- How?

What does Simple IoT Display Look Like?

HTTP POST
http://myFakeAPI.birkankolcu.com

```
{
  “message”: “I am alive!”
}
```

What does Simple IoT Display Look Like?

Example Curl Command

curl --location --request POST
'**https://yoev9tai04.execute-api.eu-central-1.amazonaws.com/prod**' \
--header 'Content-Type: application/json' \
--data-raw '**{**
"message": "I am alive!"
}'

Is it *Really* Cheap?

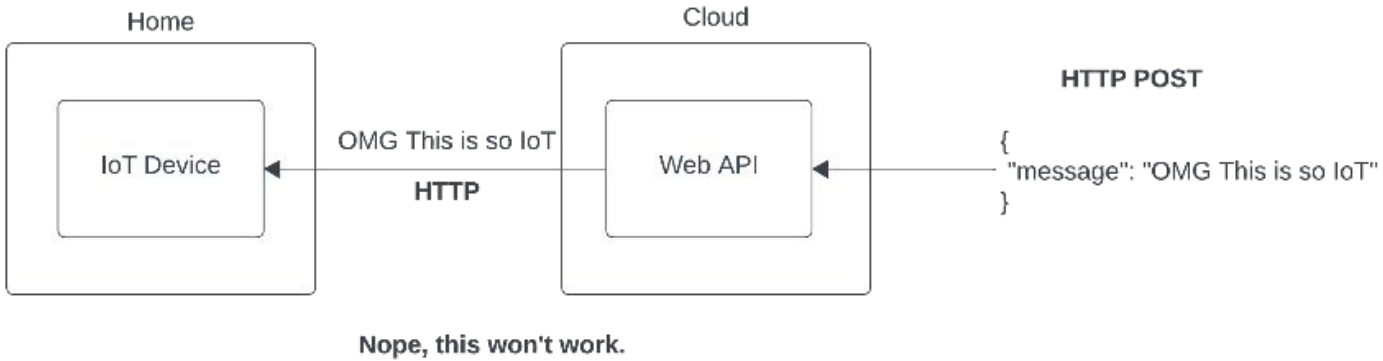
- Display: 3.4€
- Nodemcu: 2.7€
- Breadboard: 1€
- Cable: 0.85€
- Shipping: 1.2€

Total cost: 8€

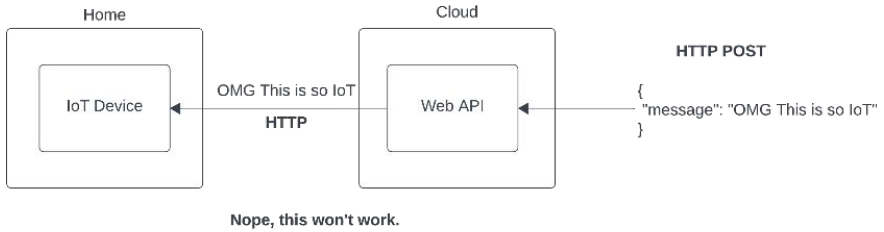
Why?

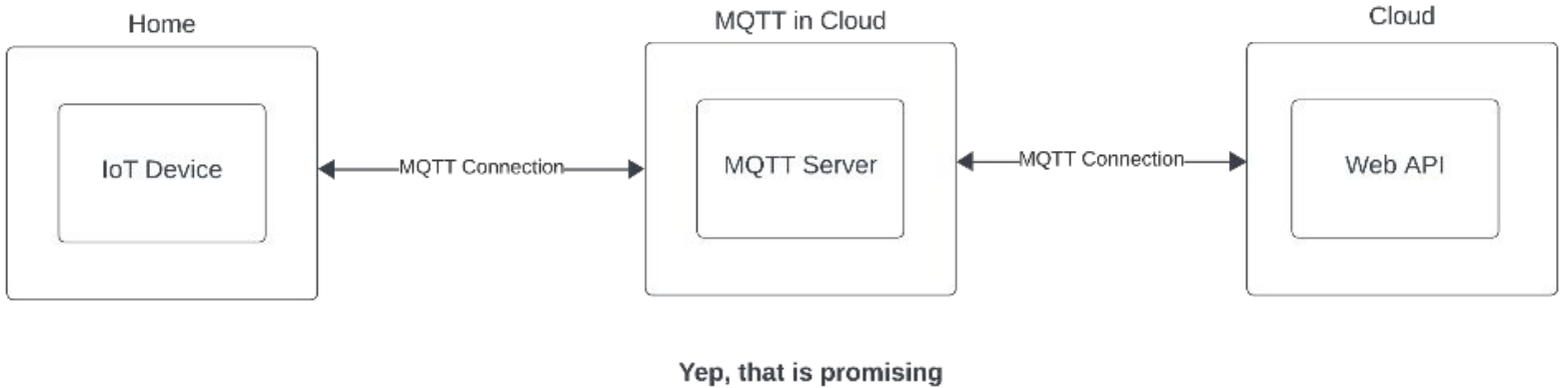
- WHY NOT!?!??!?!?!
- A lot of different technologies to experiment with. It is interesting learning experience.
- Possible interesting use cases if you think hard enough :D
  - Display number of active users on your website.
  - Display estimated end of month infrastructure cost.
  - Display (non critical) alerts.
  - Display any live info you can fetch over the internet.
  - Your suggestions?

How? - Architecture (not)

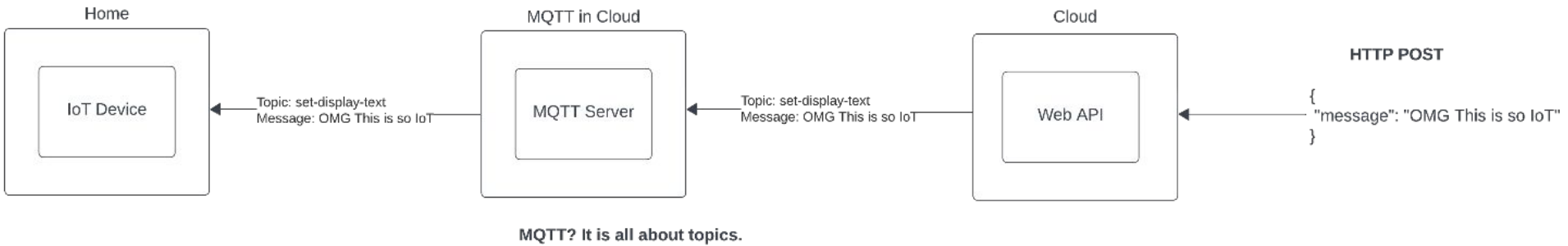


How? - Architecture

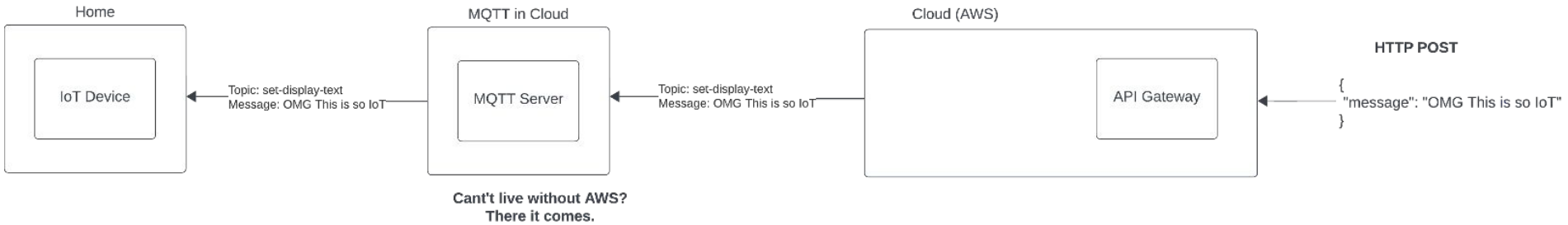




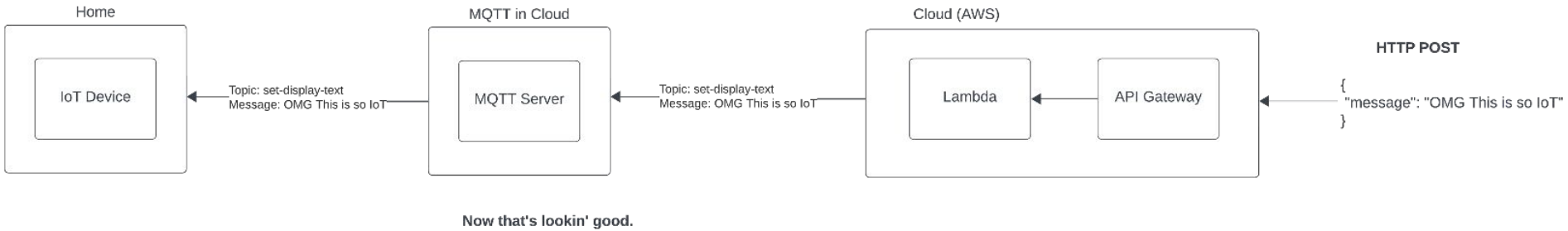
How? - Architecture



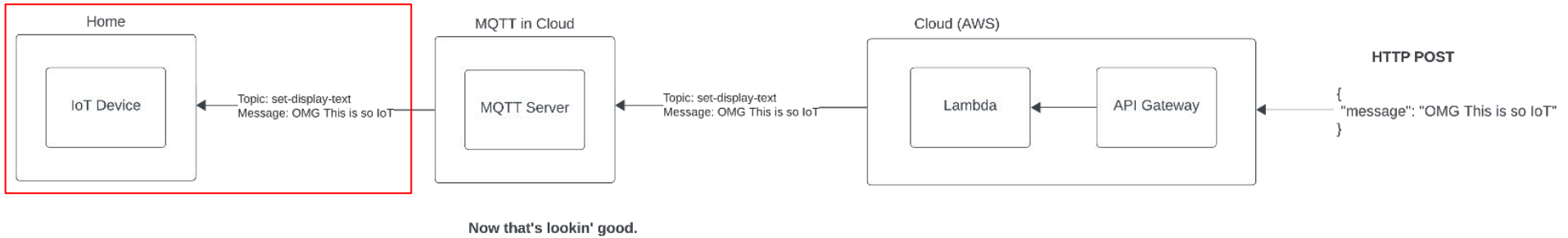
How? - Architecture



How? - Architecture

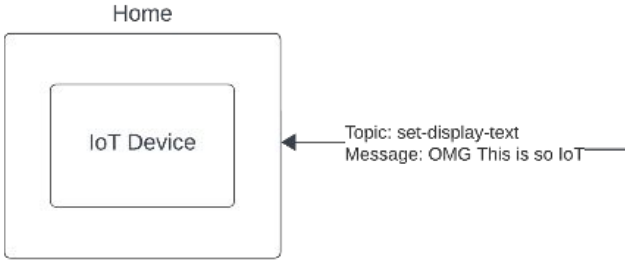


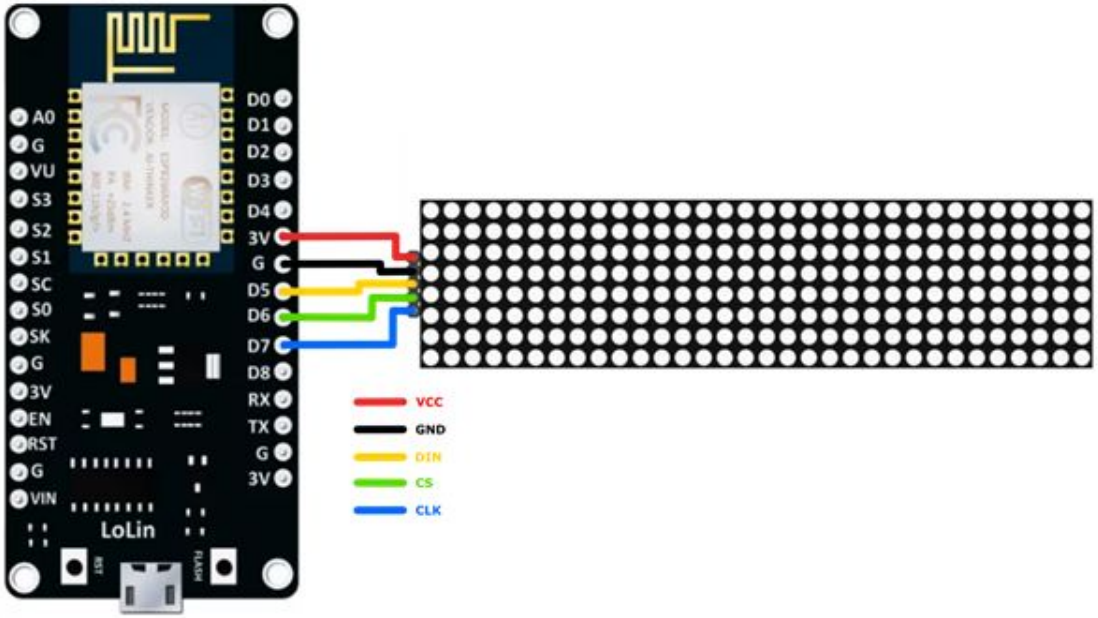
How? - Zooming into IoT Device



Now that's lookin' good.

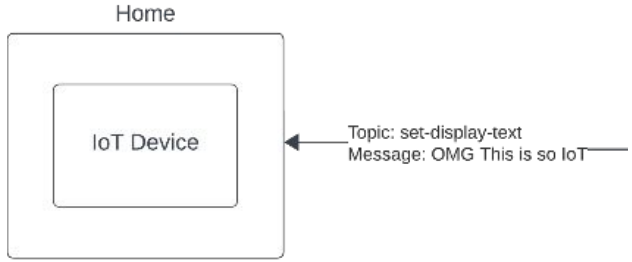
How? - IoT Device -> Nodemcu + LED

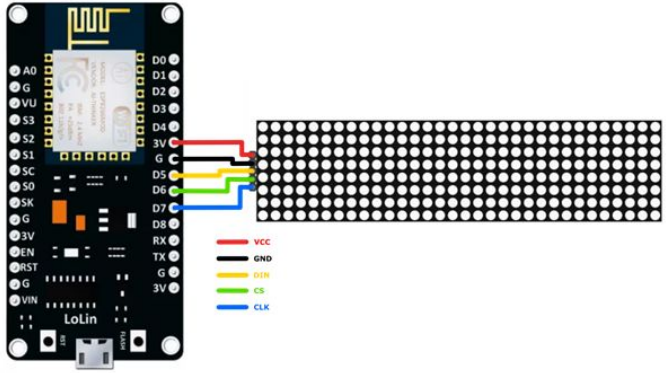




How? - Gathering Examples to Build It

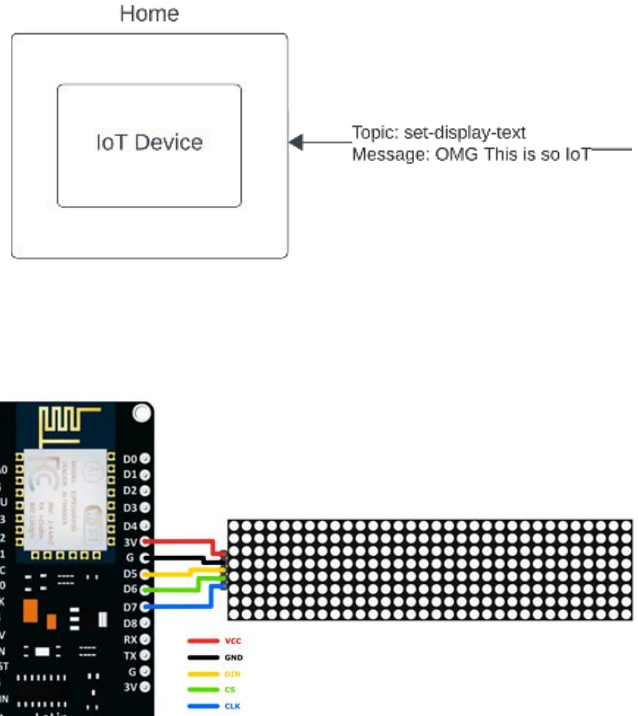
- How to use “Dot Matrix Display” with Nodemcu
- How to connect Nodemcu to MQTT (HiveMQ)
- Tiny modification to combine two examples together.



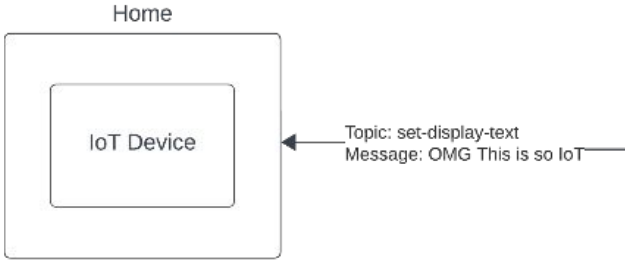


How? - Subscribe to MQTT Topic

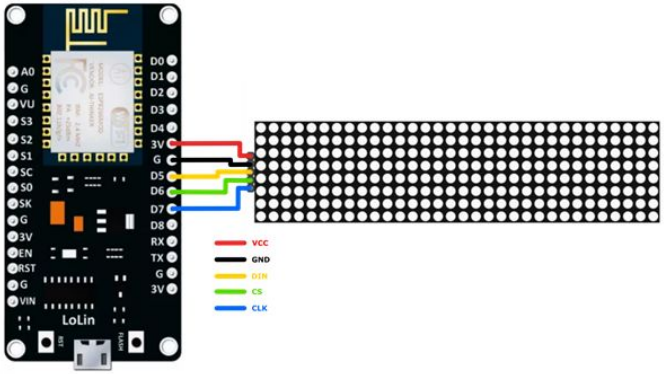
```
99    /************ Connect to MQTT Broker ***********/
100   void reconnect() {
101     // Loop until we're reconnected
102     while (!client.connected()) {
103       Serial.print("Attempting MQTT connection...");
104       String clientId = "ESP8266Client-";   // Create a random client ID
105       clientId += String(random(0xffff), HEX);
106       // Attempt to connect
107       if (client.connect(clientId.c_str(), mqtt_username, mqtt_password)) {
108         Serial.println("connected");
109
110         client.subscribe("set_led_display");   // subscribe the topics here
111
112           DynamicJsonDocument doc(1024);
113           doc["deviceId"] = "NodeMCU";
114           doc["status"] = "connected";
115           char mqtt_message[128];
116           serializeJson(doc, mqtt_message);
117           publishMessage("esp8266_data", mqtt_message, true);
118
119       } else {
120         Serial.print("failed, rc=");
121         Serial.print(client.state());
122         Serial.println(" try again in 5 seconds");   // Wait 5 seconds before retrying
123         delay(5000);
124       }
125     }
126   }
```



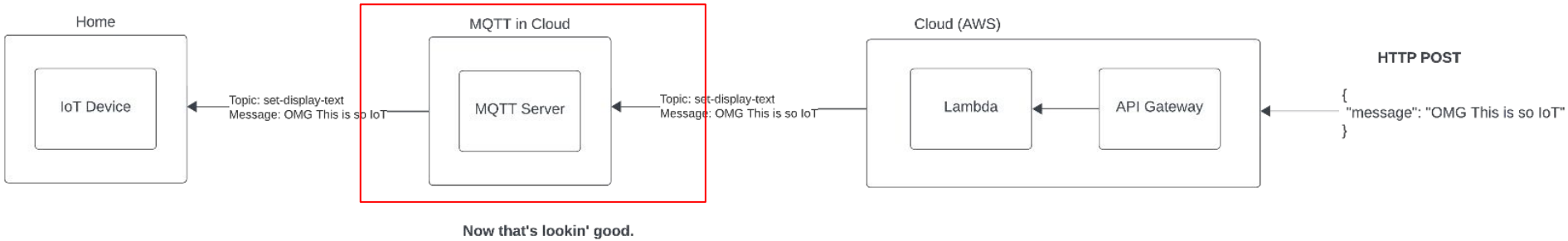
How? - Update Display Upon Message



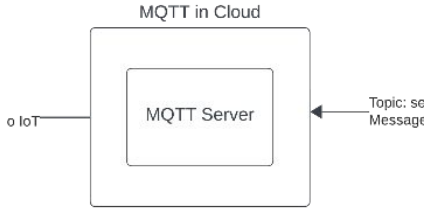

```
128  /***** Call back Method for Receiving MQTT messages and Switching LED ****/
129  String dotmatrixText = "";
130
131  void callback(char* topic, byte* payload, unsigned int length) {
132    String incommingMessage = "";
133    for (int i = 0; i < length; i++) incommingMessage+=(char)payload[i];
134
135    Serial.println("Message arrived ["+String(topic)+"]"+incommingMessage);
136
137    //--- check the incomming message
138     if( strcmp(topic,"set_led_display") == 0){
139        dotmatrixText = incommingMessage;
140        const char* myCharArray = dotmatrixText.c_str();
141        Serial.println(myCharArray);
142        myDisplay.displayClear();
143        myDisplay.displayScroll(myCharArray, PA_CENTER, PA_SCROLL_LEFT, 200);
144    }
145
146  }
147
```



How? - Zooming into MQTT Server



How? - MQTT Server: HiveMQ, FREE!



Cluster Details

OVERVIEW | ACCESS MANAGEMENT | INTEGRATIONS NEW | WEB CLIENT

Data

Clusters

FREE #1 Serverless

Billing

Billing & Payment

What's new

Cluster Information

Current Plan
Serverless

Current Tier
FREE

Name
[redacted]

Cloud Provider
Azure

CHANGE PLAN TO PAY AS YOU GO

▶ What is included in my plan?

Connection Settings

Cluster URL EDIT
[redacted].s2.eu.hivemq.cloud

Port
8883

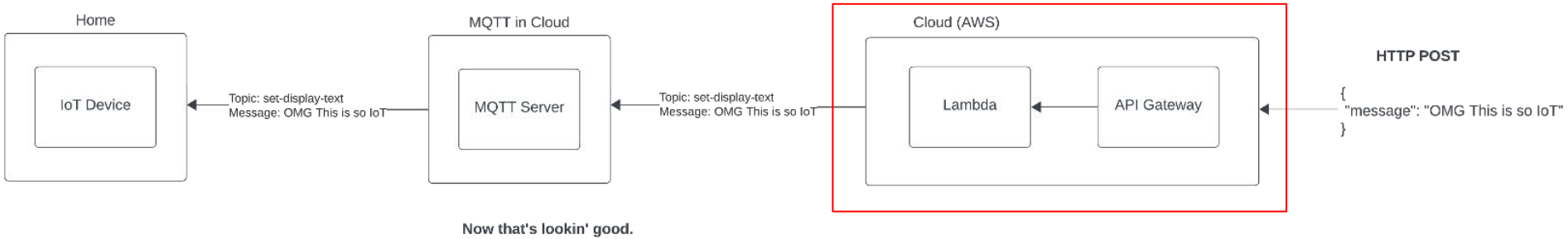
Websocket Port
8884

Current Usage

MQTT Client Sessions
2 / 100
Last update
2 minutes ago
Price per session
FREE

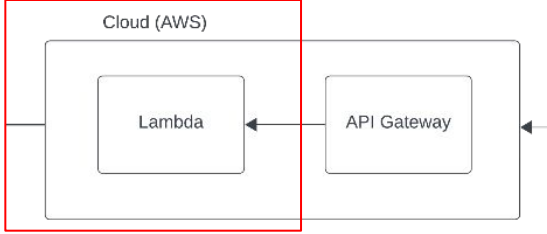
Data Traffic
28.5 kB / 10 GB
Last update
2 minutes ago
Price per GB
FREE

How? - Zooming into AWS



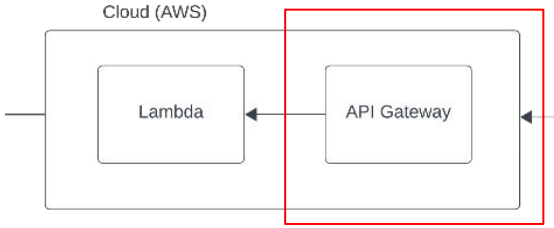
Now that's lookin' good.

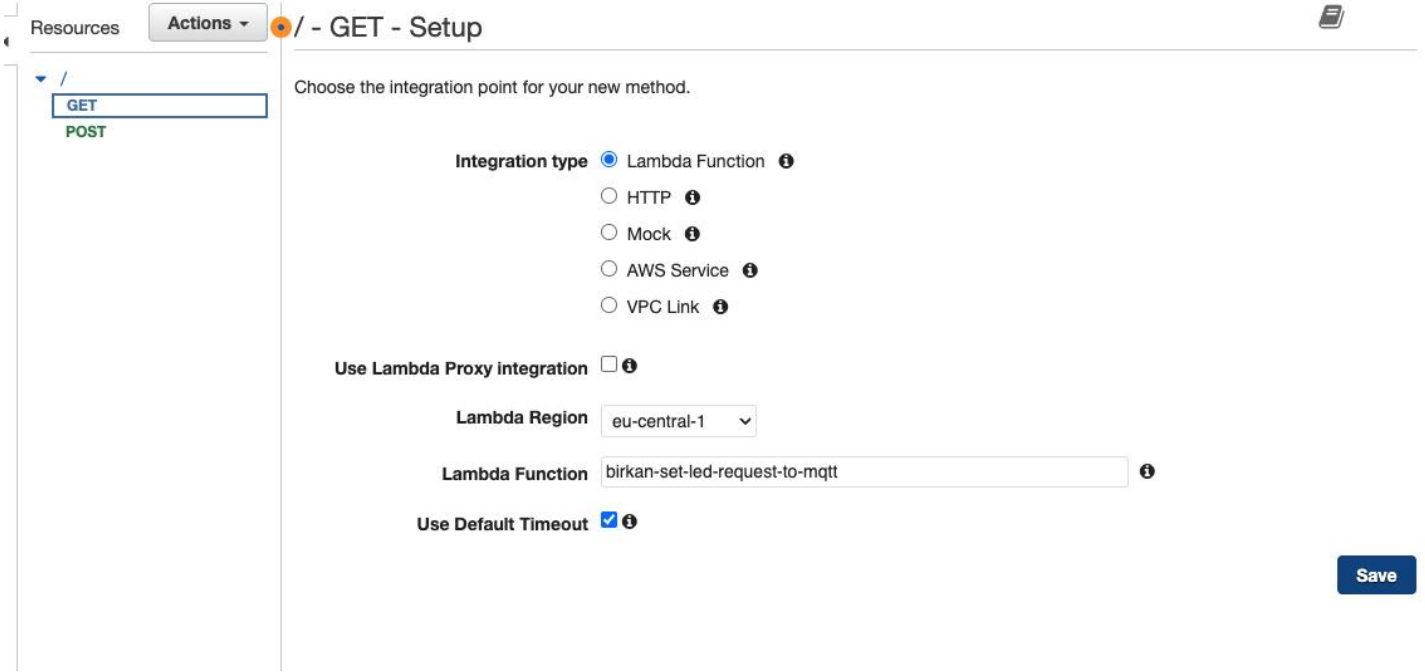
How? - Lambda



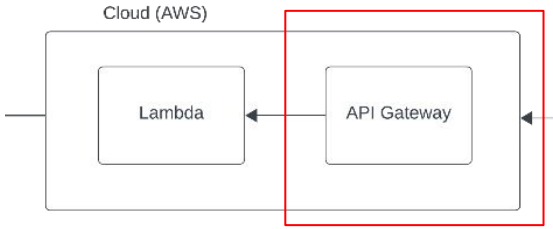

```
import * as mqtt from "mqtt";

export const handler = async (event) => {
  console.log("PRINTIN EVENT")
  console.log(event)

  const mqttClient = mqtt.connect('mqtt://[redacted].s2.eu.hivemq.cloud', {
    username: 'backend-mqtt',
    password: '[redacted]',
    port: 8883,
    protocol: 'mqtts'
  });


  return new Promise((resolve, reject) => {
    mqttClient.on('connect', () => {
      mqttClient.publish('set_led_display', event.message, (err) => {
        if (err) {
          reject(err);
        } else {
          const response = {
            statusCode: 200,
            body: JSON.stringify('Message sent to MQTT broker!'),
          };
          resolve(response);
        }
        mqttClient.end(); // Close the connection
      });
    });

    mqttClient.on('error', (err) => {
      reject(err);
    });
  });
};
```

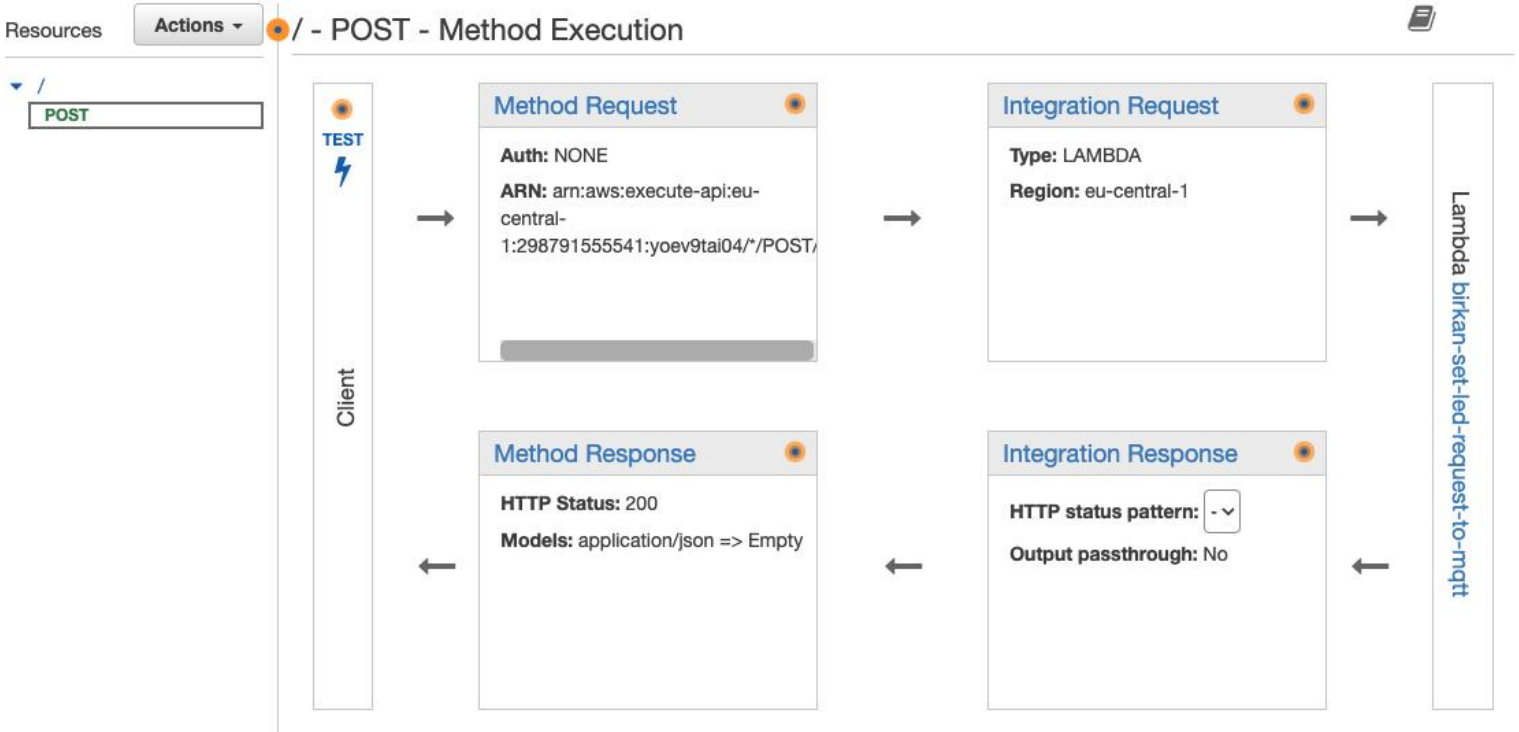
How? - API Gateway



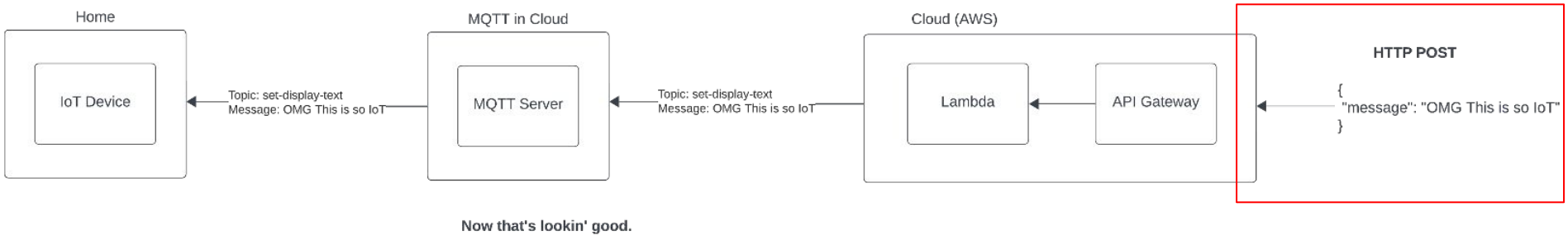


How? - API Gateway





How? - Zooming into API



Now that's lookin' good.

How? - API Gateway Expose our API to World

HTTP POST

https://yoev9tai04.execute-api.eu-central-1.amazonaws.com/prod'

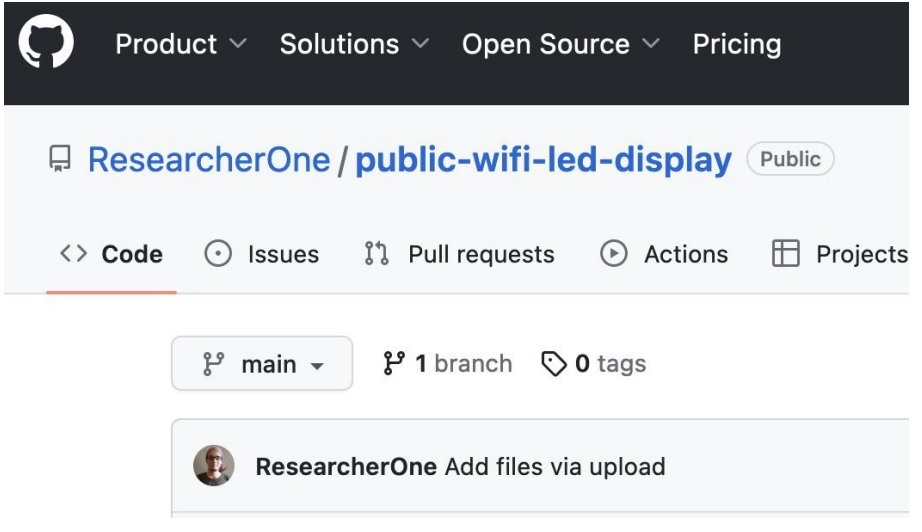
```
{
   "message": "OMG this is so IoT"
}
```

Example Curl Command

curl --location --request POST
'**https://yoev9tai04.execute-api.eu-central-1.amazonaws.com/prod**' \
--header 'Content-Type: application/json' \
--data-raw '**{**
"message": "OMG this is so IoT"
}'

Talk is Cheap Show Me The Code

https://github.com/ResearcherOne/public-wifi-led-display



The End (?)

THX FOR LISTENING!