IoT Protocol (HTTP & MQTT)

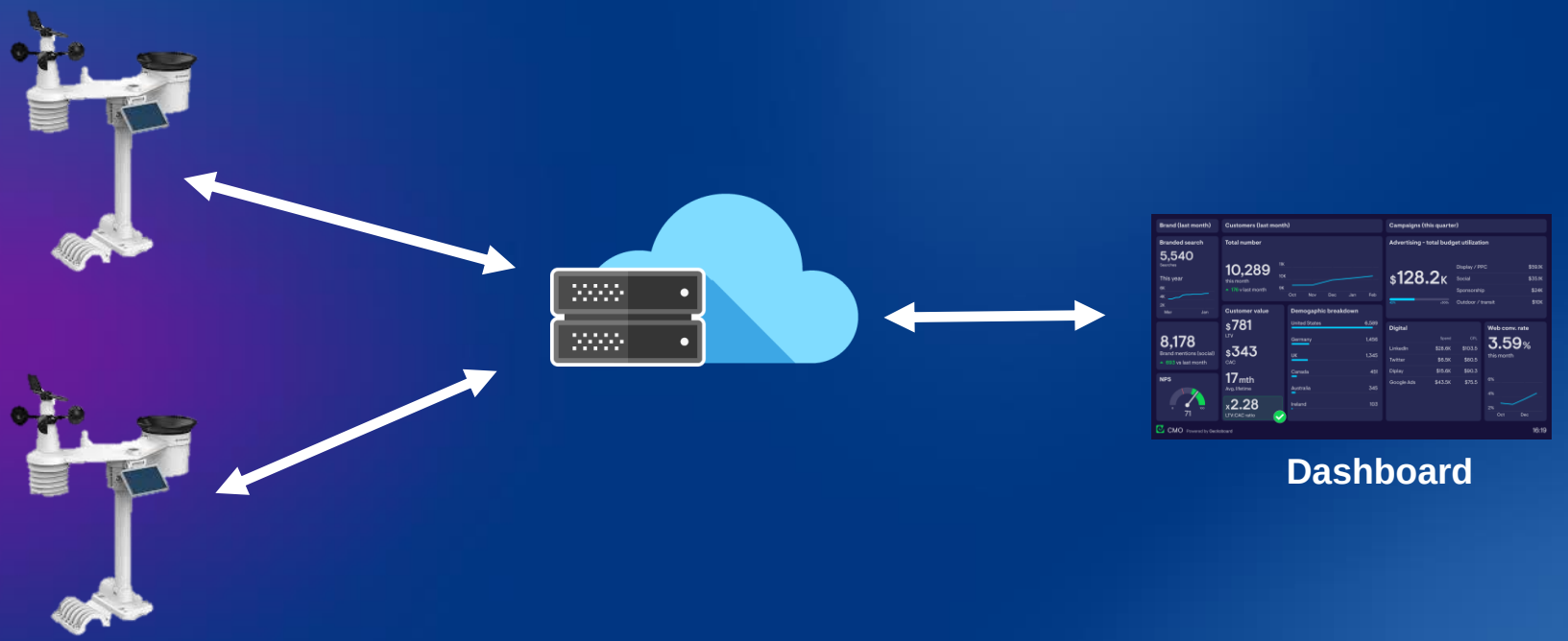
Bootcamp - Menjadi IoT Engineer

Edspert.id

Sony Alfathani LinkedIn

Contents

Sending Data

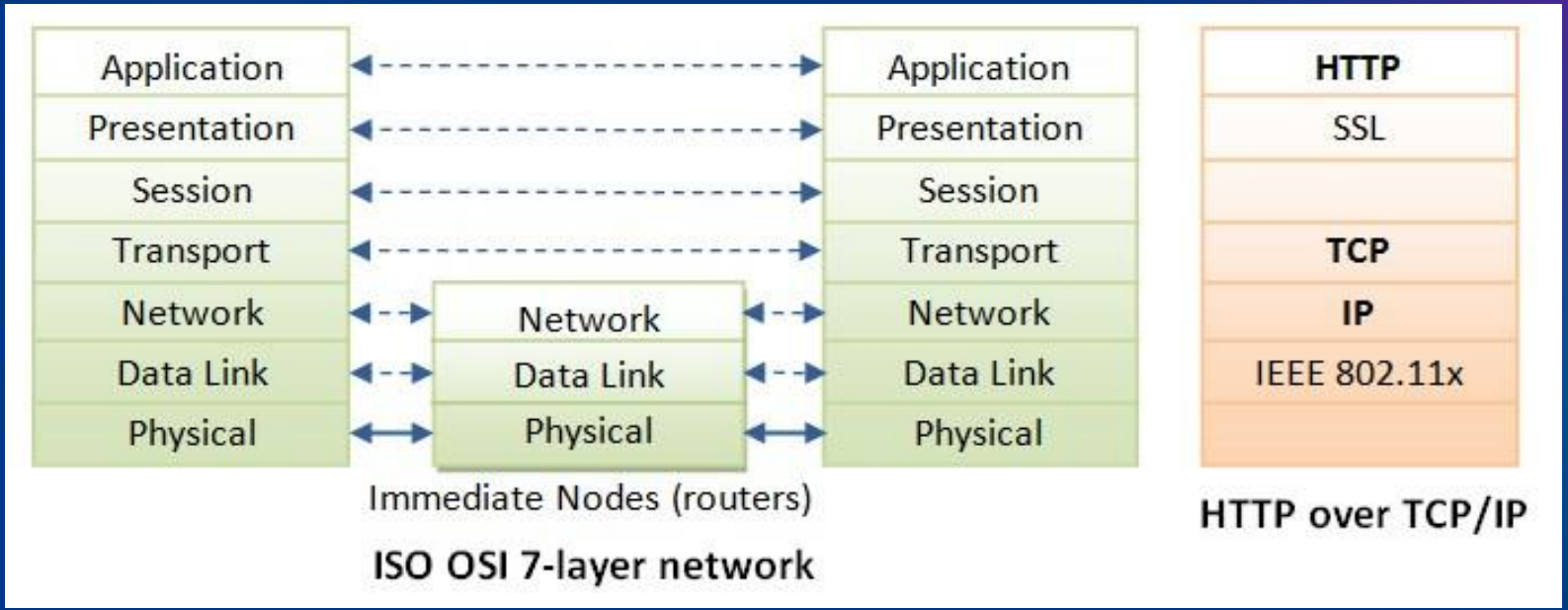


Dashboard

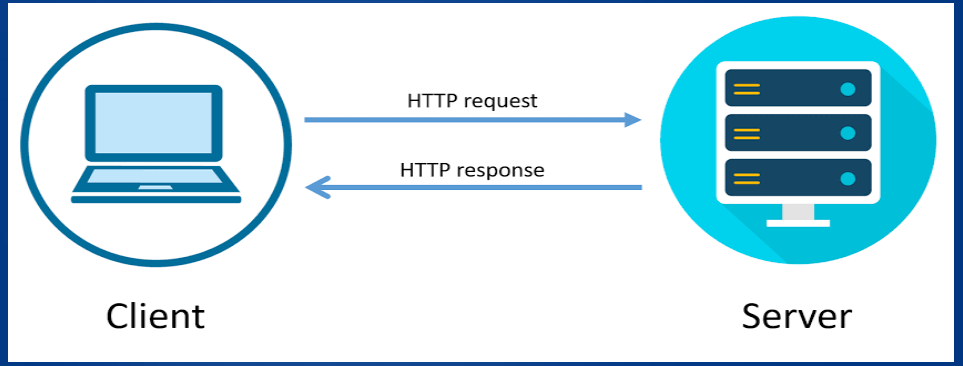
We need a protocol

Apa itu HTTP ?

HTTP (Hypertext Transfer Protocol) merupakan protokol yang bersifat **request-response**, yang digunakan di Internet yang memungkinkan client-server berkomunikasi satu sama lain. HTTP adalah protokol yang terletak pada lapisan aplikasi, berada di atas protokol TCP (Transfer Control Protocol) dalam OSI Layer Protocol.



HTTP Request-Response



Requests

```
POST / HTTP/1.1
Host: localhost:8000
User-Agent: Mozilla/5.0 (Macintosh;… )… Firefox/51.0
Accept: text/html,application/xhtml+xml,…,*/*;q=0.8
Accept-Language: en-US,en;q=0.5
Accept-Encoding: gzip, deflate
Connection: keep-alive
Upgrade-Insecure-Requests: 1
Content-Type: multipart/form-data; boundary=-12656974
Content-Length: 345

-12656974
(more data)
```

start-line

HTTP headers

empty line

body

Responses

```
HTTP/1.1 403 Forbidden
Server: Apache
Content-Type: text/html; charset=iso-8859-1
Date: Wed, 10 Aug 2016 09:23:25 GMT
Keep-Alive: timeout=5, max=1000
Connection: Keep-Alive
Age: 3464
Date: Wed, 10 Aug 2016 09:46:25 GMT
X-Cache-Info: caching
Content-Length: 220

<!DOCTYPE HTML PUBLIC "-//IETF//DTD HTML
2.0//EN">
(more data)
```

Struktur HTTP Request

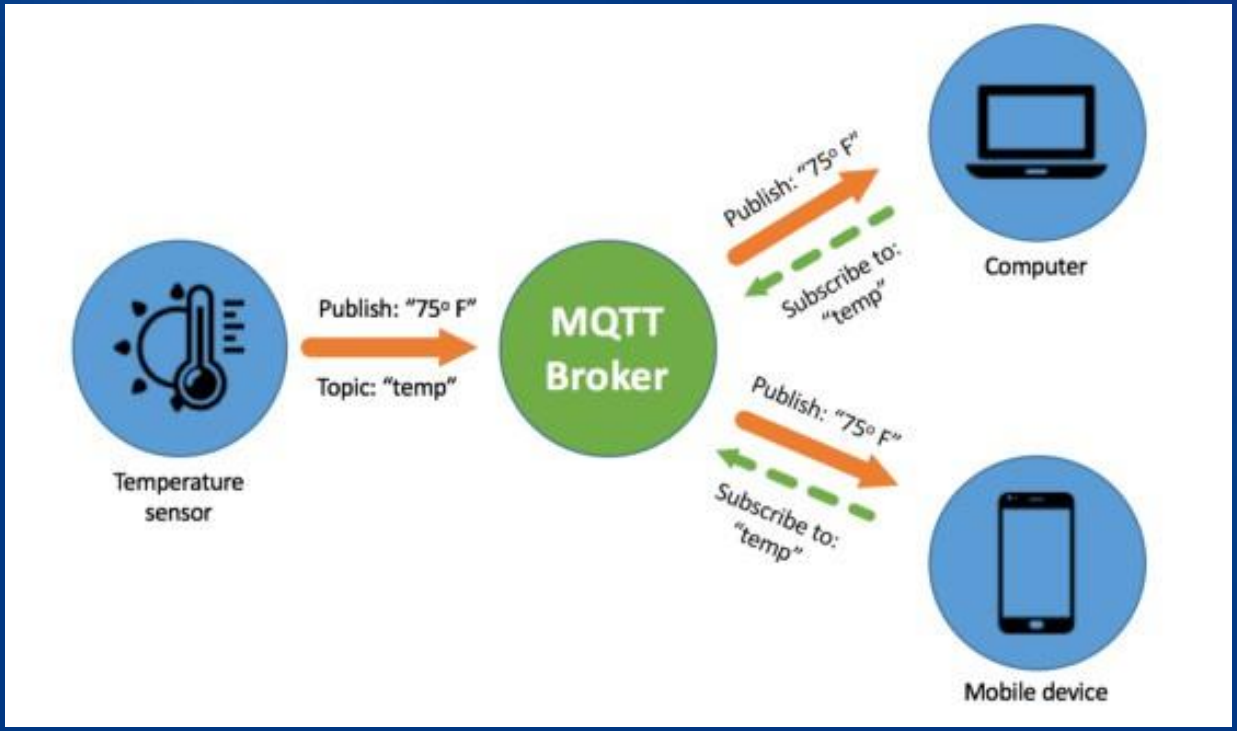
- Request Method (ex. `GET / POST`)
- Header (`host:server.address.com, accept-language:en-us, content-type:text/html`)
- Empty line
- Message body (opsional)

Struktur HTTP Response

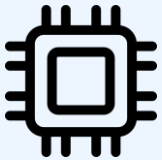
- HTTP status code (ex. `400 / 404 / 500 / 200`)
- Header (ex. Content-type: html)
- Empty line
- Response body with requested file (opsional)

Apa itu MQTT ?

Message Queuing Telemetry Transport merupakan protokol messaging yang menggunakan model **Publish-Subscribe**.



Komponen MQTT



CLIENT

- Publishers and Subscribers.
- Connect to broker.
- Create specific topic.

BROKER

- Receiving.
- Filtering.
- Determining.
- Sending.

CONNECTION

- Based on TCP/IP.
- Send CONNECT.
- Client never connect to each other directly.

MQTT QoS

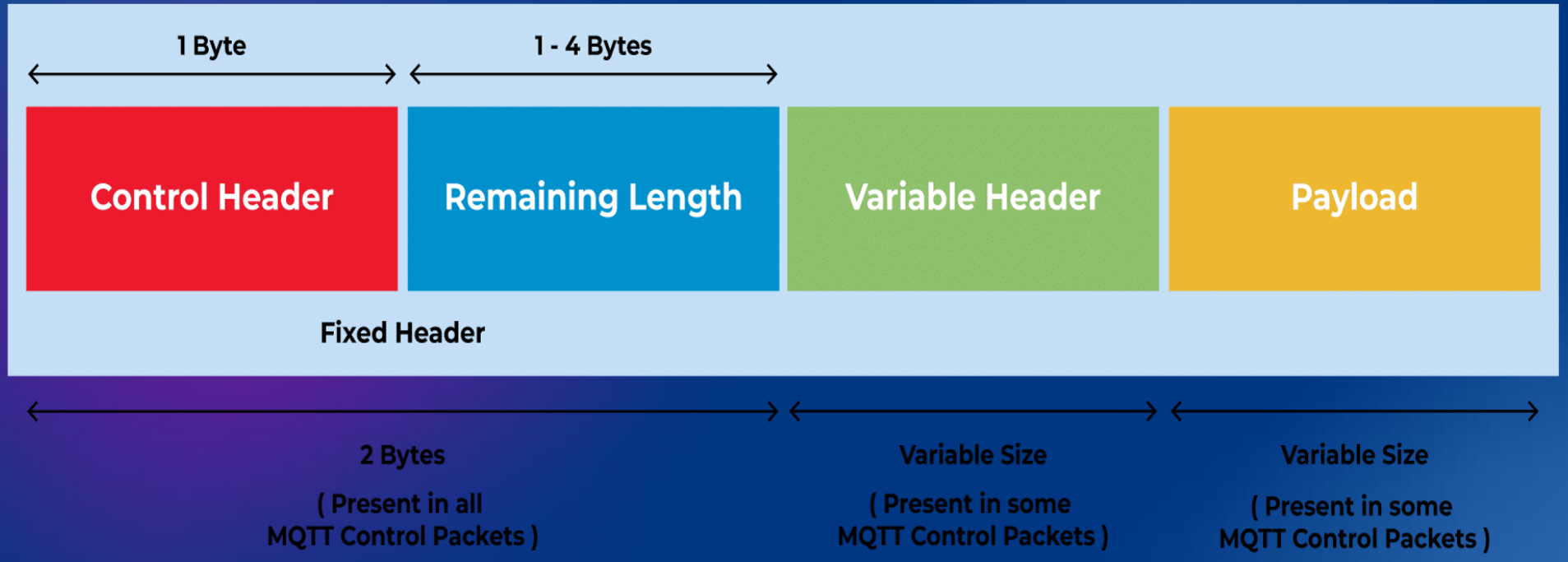
Tingkat kualitas layanan pengiriman atau ***Quality of Service*** **(QoS)** pada MQTT terdapat Tiga level :

1. **QoS 0 (at most once delivery)** : pesan hanya dikirim sekali, setelah pesan dikirim tidak ada respon apakah pesan berhasil dikirim, pesan bisa saja tidak terkirim, atau tidak diterima *subscriber.*

2. **QoS 1 (at least once delivery)** : pesan paling sedikit dikirim sekali, jika *subscriber* tidak menerima pesan maka broker akan mengirim respon terhadap *publisher* bahwa pesan gagal dikirim.

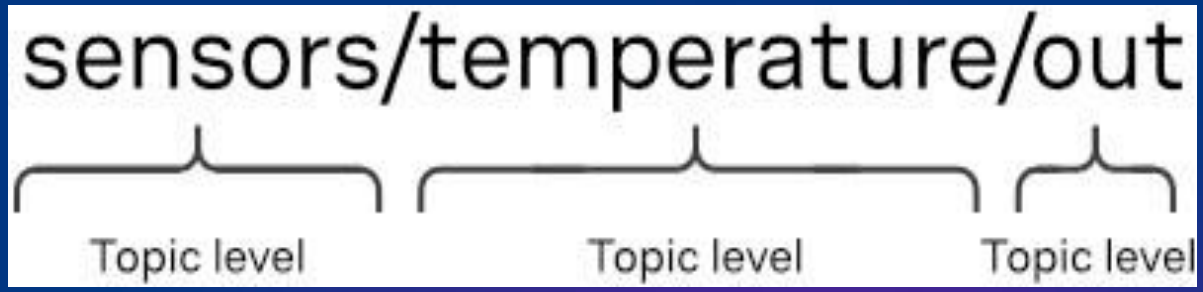
3. **QoS 2 (exactly once delivery)** : pesan dikirim sekali dan hanya sekali. QoS 2 memastikan bahwa pesan diterima *subscriber.*

MQTT Packet Format



MQTT Topic

MQTT Topic Wildcard



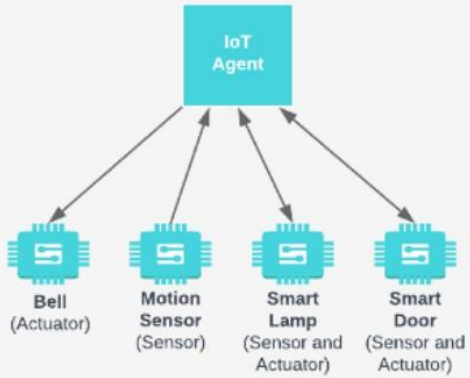
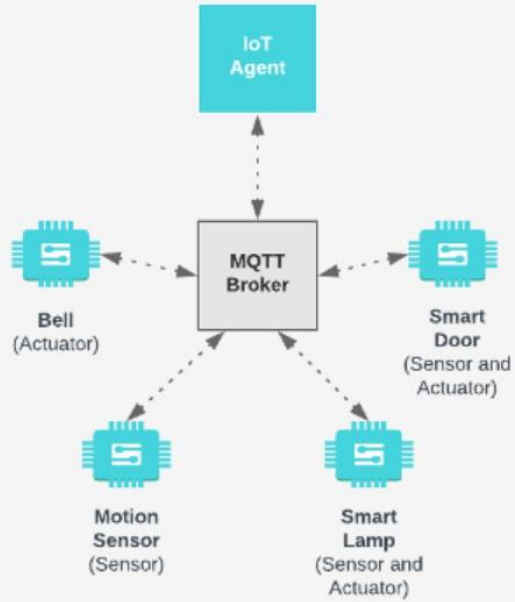
Single-level

- ✅ myhome / groundfloor / livingroom / temperature
- ✅ myhome / groundfloor / kitchen / temperature
- ❌ myhome / groundfloor / kitchen / brightness
- ❌ myhome / firstfloor / kitchen / temperature
- ❌ myhome / groundfloor / kitchen / fridge / temperature

Multi-level

- ✅ myhome / groundfloor / livingroom / temperature
- ✅ myhome / groundfloor / kitchen / temperature
- ✅ myhome / groundfloor / kitchen / brightness
- ❌ myhome / firstfloor / kitchen / temperature

Compare

HTTP Transport	MQTT Transport
	
IoT Agent communicates with IoT devices **directly**	IoT Agent communicates with IoT devices **indirectly** via an MQTT Broker
Request-Response Paradigm	**Publish-Subscribe** Paradigm
IoT Devices must always be ready to receive communication	IoT Devices choose when to receive communication
Higher Power Requirement	Low Power Requirement

MQTT	HTTP
- Lower bandwidth usage	- Lighter weight
- Lower latency, higher throughout	- Fewer firewall issues
- Supports raw binary data	- Binary data must be base64-encoded

By @widyaedu

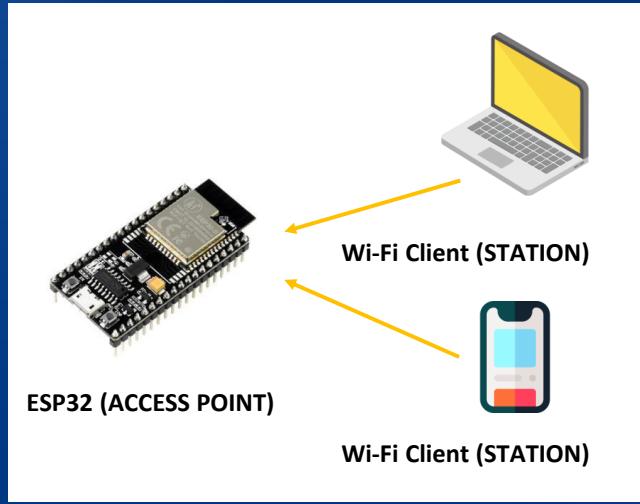
ESP Connection

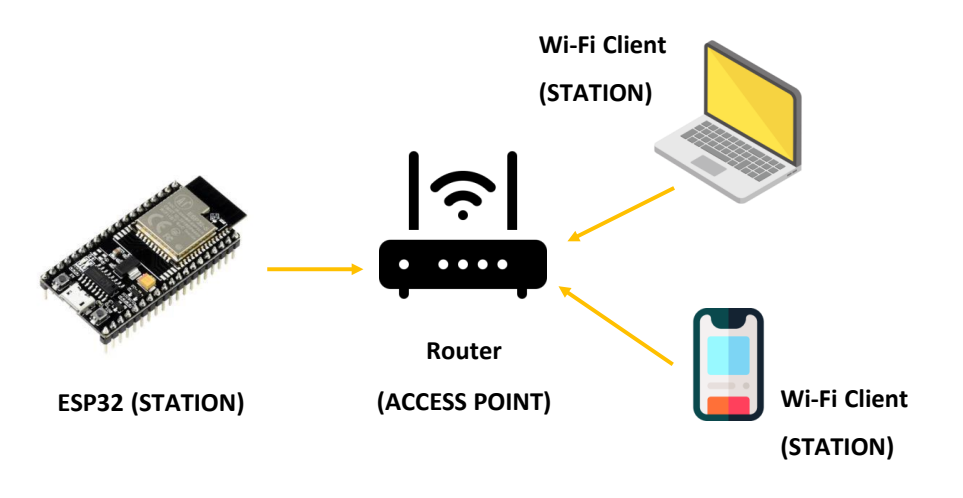
Wi-Fi Mode

#include <WiFi.h>

Library ini digunakan untuk Modul WiFi yang tersedia pada board ESP, library ini secara otomatis akan terinstal ketika anda menambahkan ESP32 ke Arduino IDE Anda.

1. **Station Mode (STA)**
2. **Access Point Mode (AP)**
3. **STA & AP Mode**

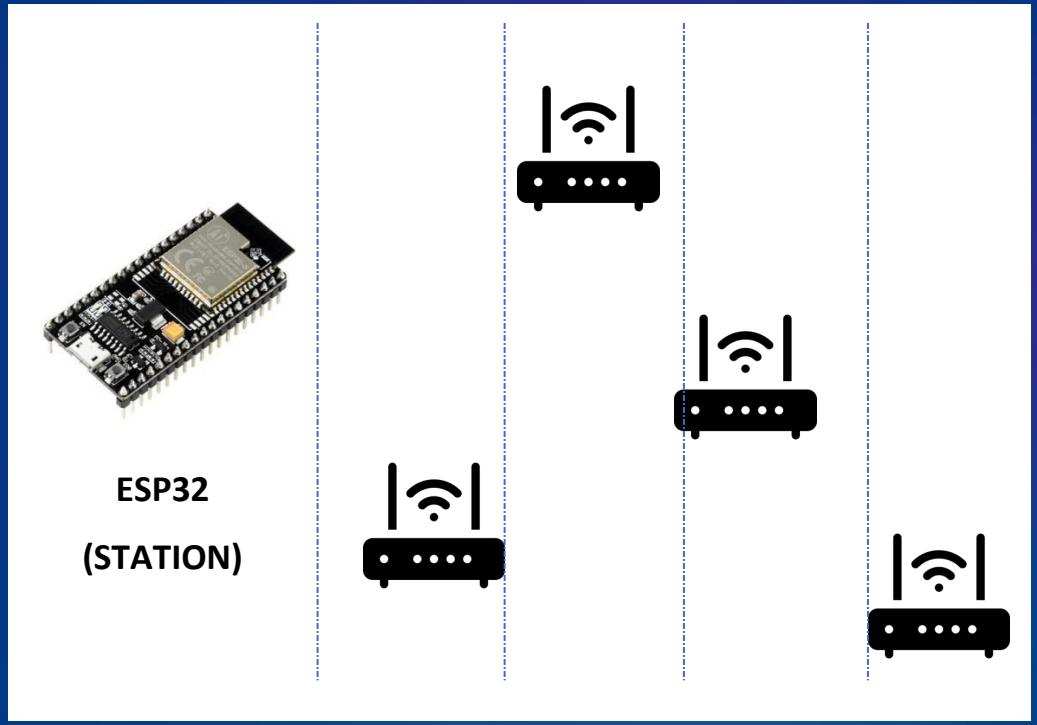




	Fungsinya
WiFi.mode(WIFI_STA)	Station Mode : ESP32 dapat connect ke AP
WiFi.mode(WIFI_AP)	Access Point mode: stations dapat terhubung ke ESP32
WiFi.mode(WIFI_STA_AP)	ESP32 dapat diatur sebagai stasiun Wi-Fi dan titik akses secara bersamaan

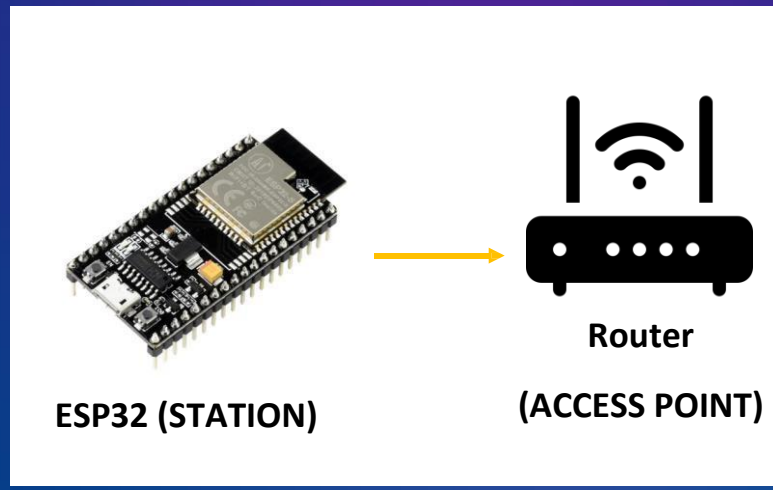
Scan Wi-Fi Networks

Function	Keterangan
WiFi.scanNetworks()	Akan memberikan nilai balikan jumlah network yang ditemukan
WiFi.SSID(i)	Mendapatkan nama SSID Wifi Network
WiFi.RSSI(i)	Mendapatkan nilai RSSI Wifi Network



Connect to Wi-Fi Networks

Function	Keterangan
WiFi.begin(ssid, password)	Untuk terhubung ke jaringan
WiFi.status()	Mendapatkan nama SSID Wifi Network
WL_CONNECTED	Konstanta / nilai ketika ESP telah terhubung ke Wi-Fi
WiFi.localIP()	Untuk mengetahui IP yang di berikan oleh router ke ESP32

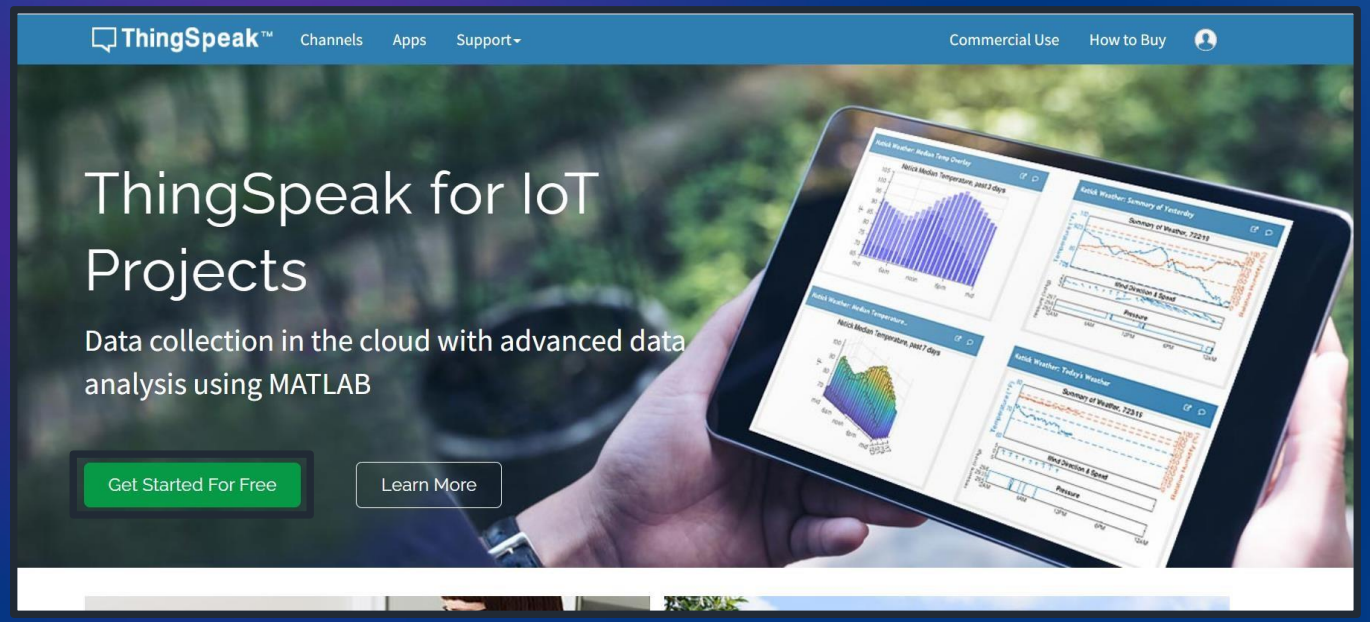


By @widyaedu

HTTP Protocol

Membuat Akun ThingSpeak

https://thingspeak.com/



1. Klik **Get Started For Free**

2. Klik Create one!

ThingSpeak™ Channels Apps Support Commercial Use How to Buy

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Non-commercial users may use ThingSpeak for free. Free accounts offer limits on certain functionality. Commercial users are eligible for a time-limited free evaluation. To get full access to the MATLAB analysis features on ThingSpeak, log in to ThingSpeak using the email address associated with your university or organization.

To send data faster to ThingSpeak or to send more data from more devices, consider the paid license options for commercial, academic, home and student usage.

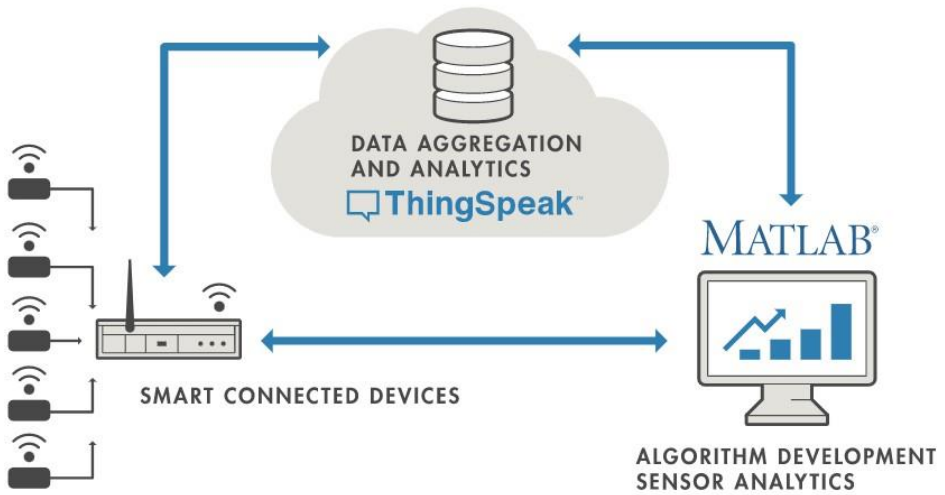
MathWorks®

Email

No account? Create one!

By signing in, you agree to our privacy policy.

Next



3. Isi semua box data dan klik Continue

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Create MathWorks Account

Email Address

emailanda@gmail.com

To access your organization's MATLAB license, use your school or work email.

Location

Tunisia

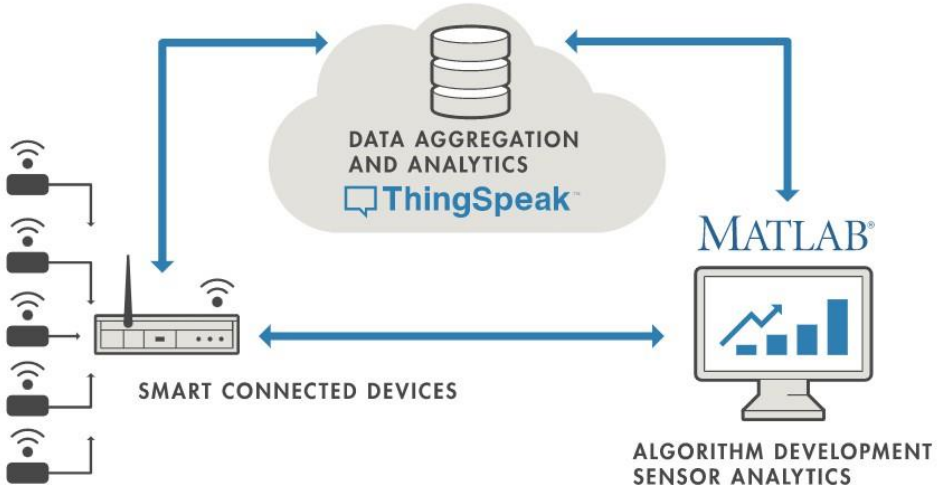
First Name

akun

Last Name

coba

Continue



4. Isi Email anda, Check list dan klik Continue

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⚠ To use your organization's MATLAB, enter your work or university email

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emailsasasa@gmail.com

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Cancel

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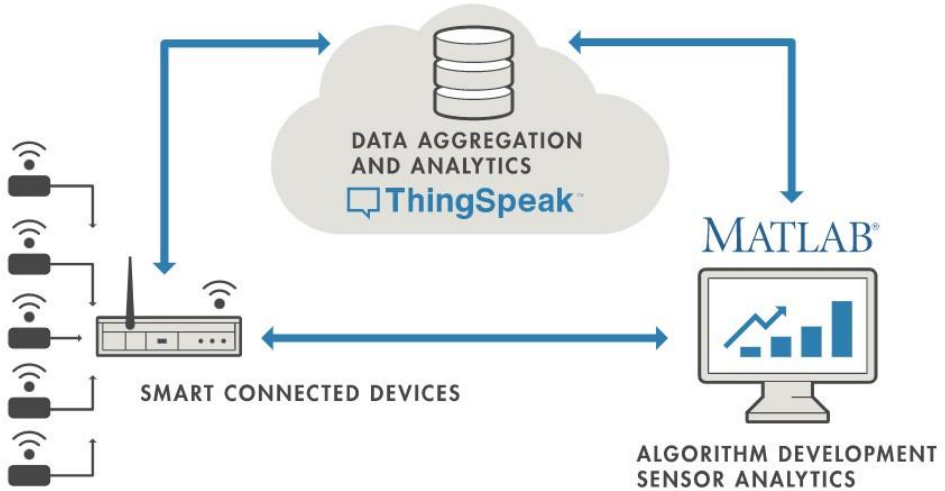
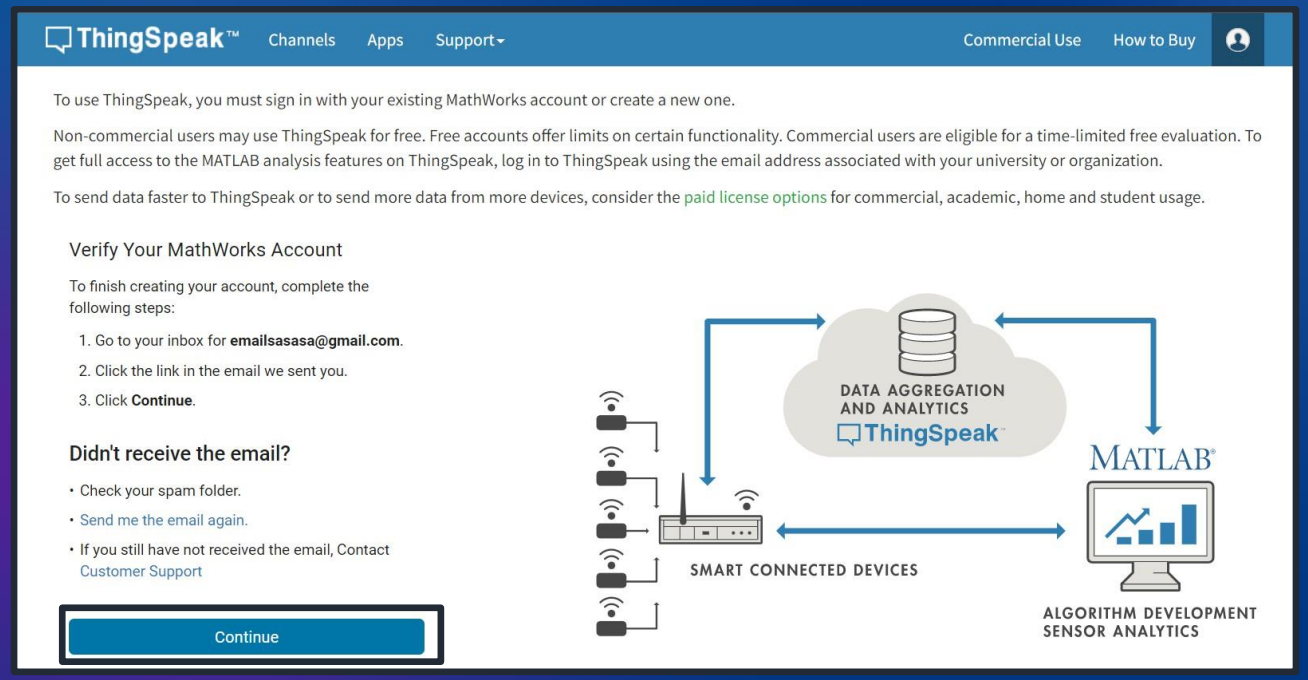
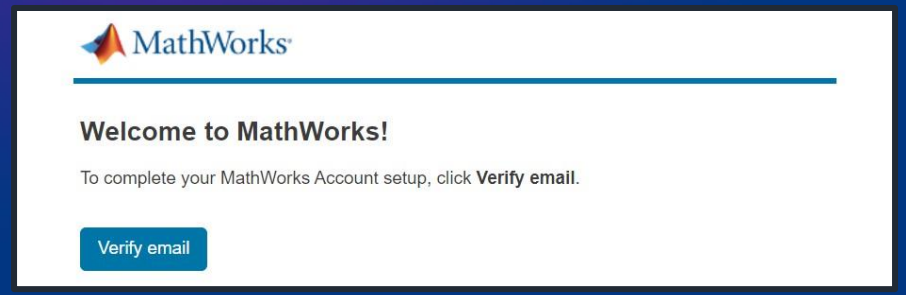
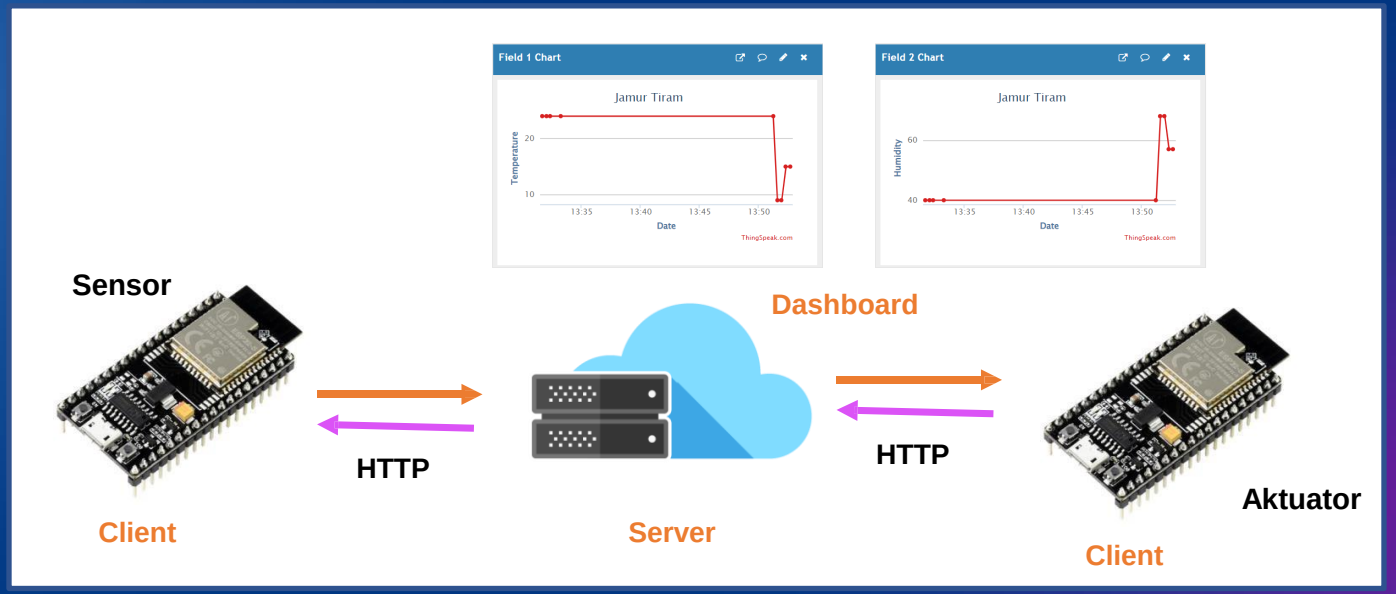


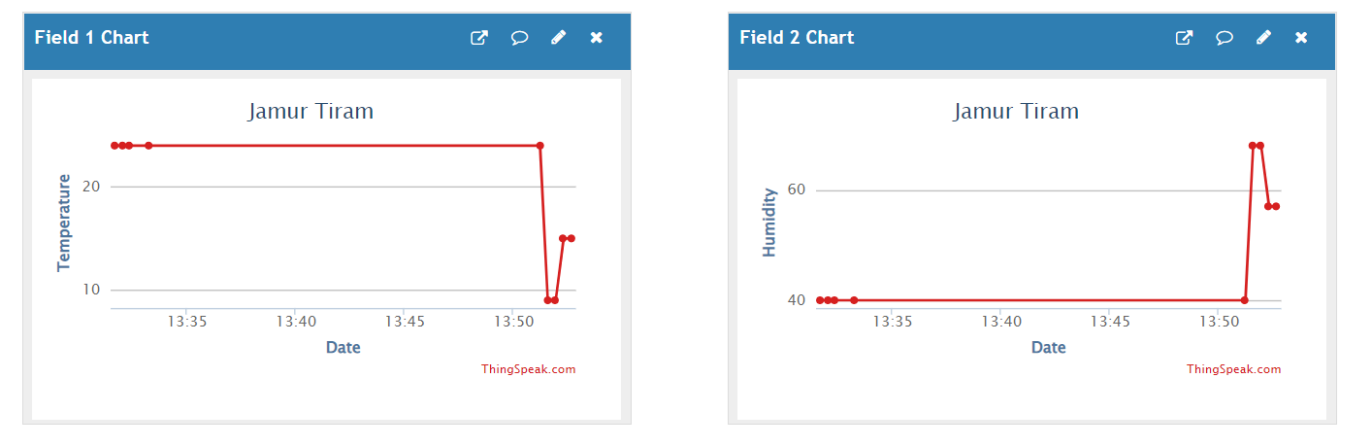
5. Verify akun melalui email anda

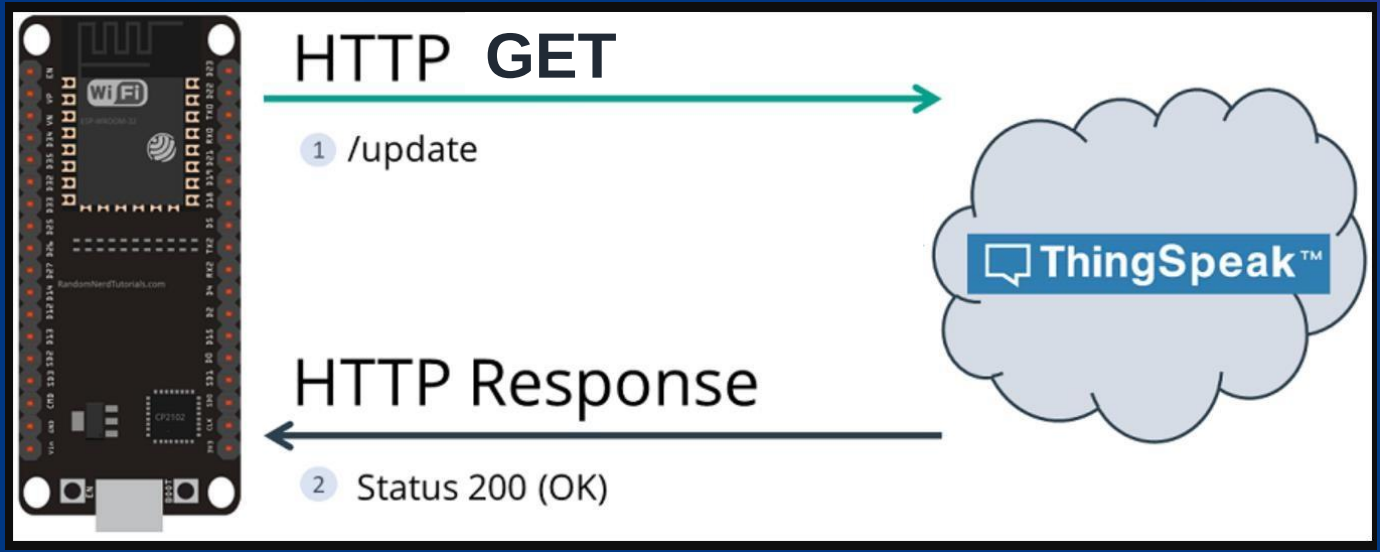


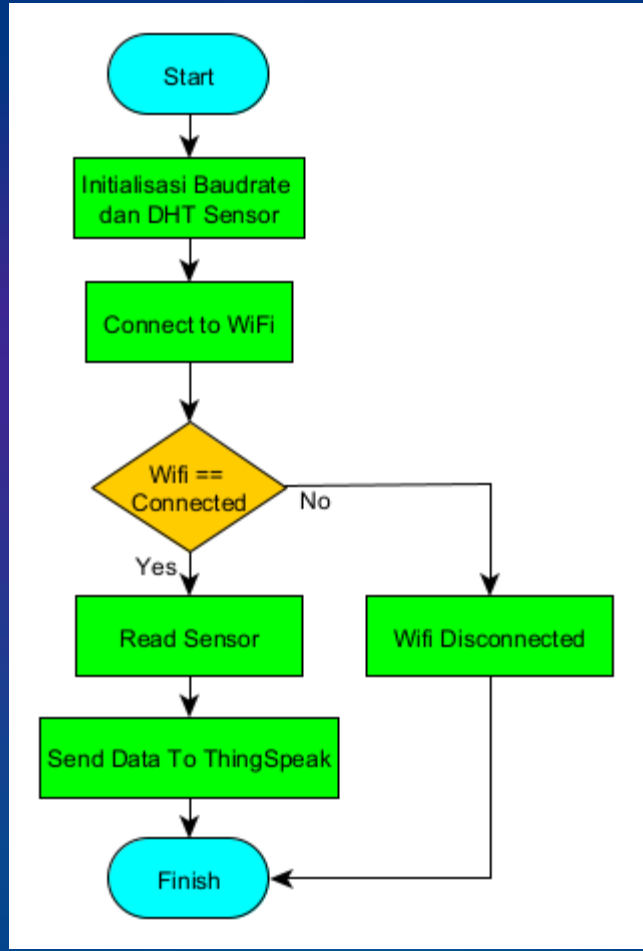




Function	Keterangan
#include <HTTPClient.h>	Panggil library HTTPClient yang menyediakan banyak metode yang akan membantu kita bekerja dengan fungsionalitas HTTP
HTTPClient httpku	Membuat suatu object “httpku”
httpku.begin()	Mendefinisikan Spesific URL tujuan request
httpku.GET();	Mengirimkan Request dengan Get Method memiliki nilai balikan

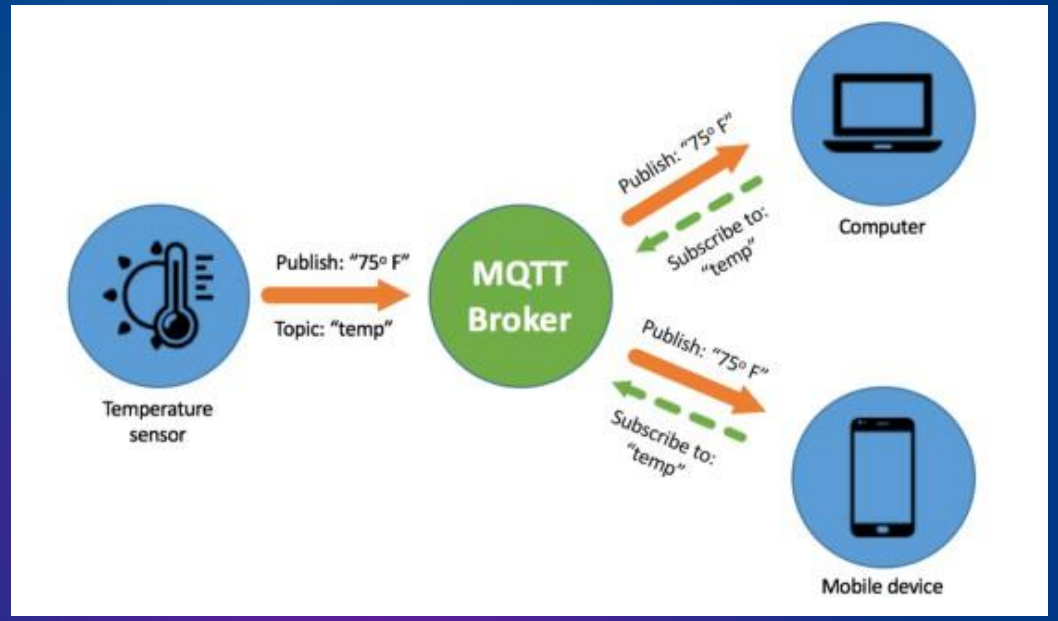

Field 1 Chart
Jamur Tiram
Temperature
20
10
13:35
13:40
13:45
13:50
Date
ThingSpeak.com
Field 2 Chart
Jamur Tiram
Humidity
60
40
13:35
13:40
13:45
13:50
Date
ThingSpeak.com

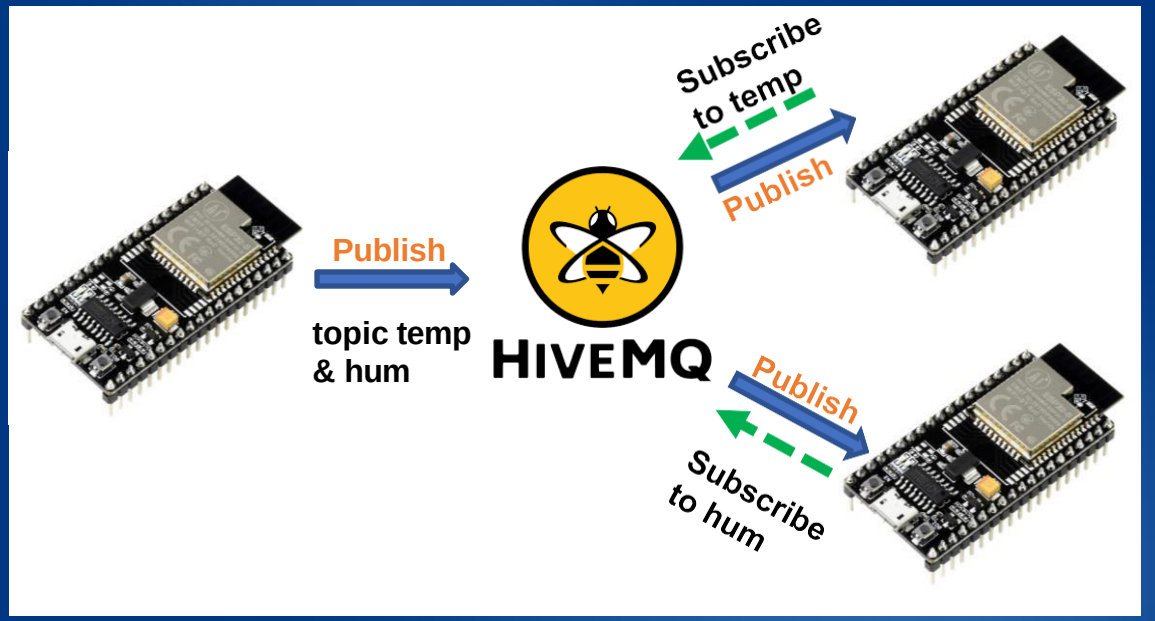

HTTP GET
1 /update
ThingSpeak™
HTTP Response
2 Status 200 (OK)


Start
Initialisasi Baudrate dan DHT Sensor
Connect to WiFi
Wifi == Connected
No
Yes
Read Sensor
Wifi Disconnected
Send Data To ThingSpeak
Finish

By @widyaedu

MQTT Protocol

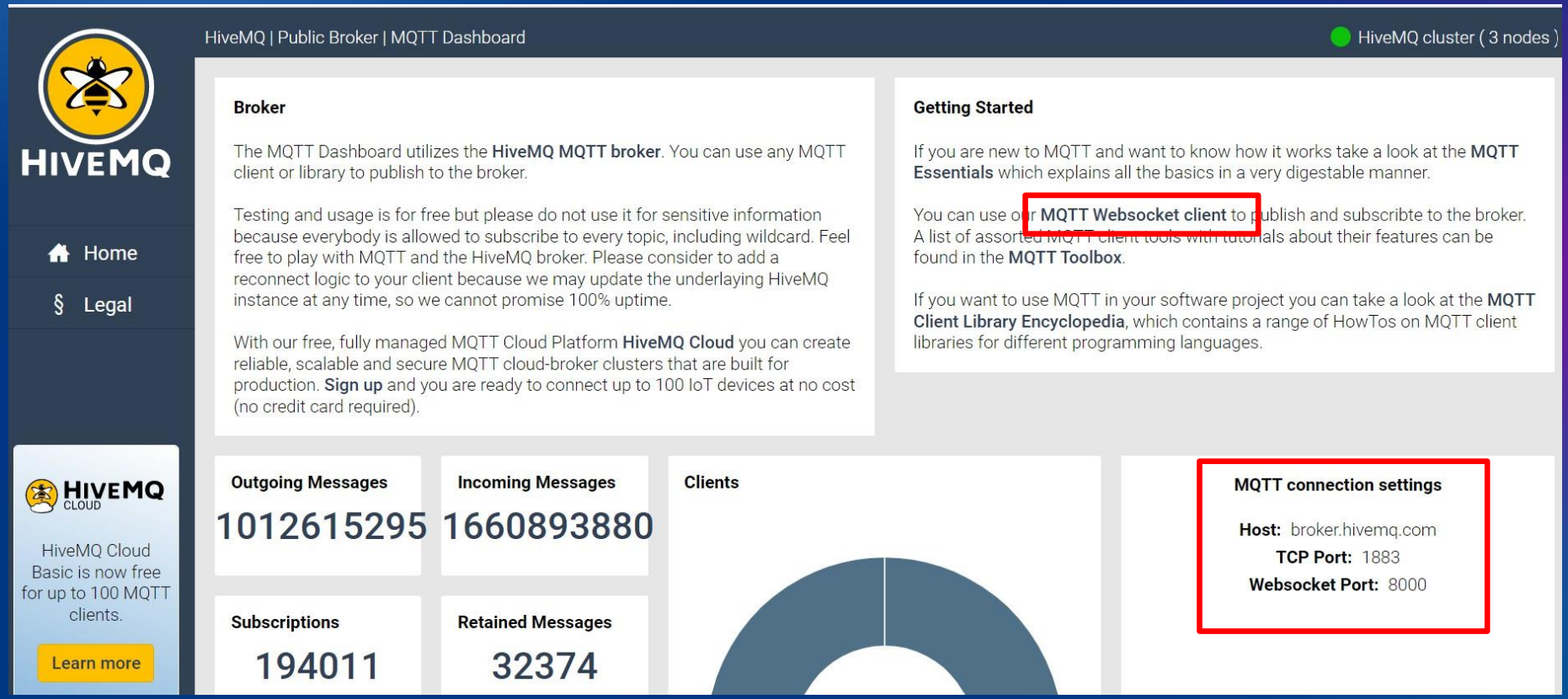

Publish: "75° F"
Subscribe to: "temp"
Computer
Publish: "75° F"
Topic: "temp"
MQTT Broker
Temperature sensor
Publish: "75° F"
Subscribe to: "temp"
Mobile device


Subscribe to temp
Publish
Publish
topic temp & hum
HIVEMQ
Publish
Subscribe to hum

Connect to Wi-Fi Networks

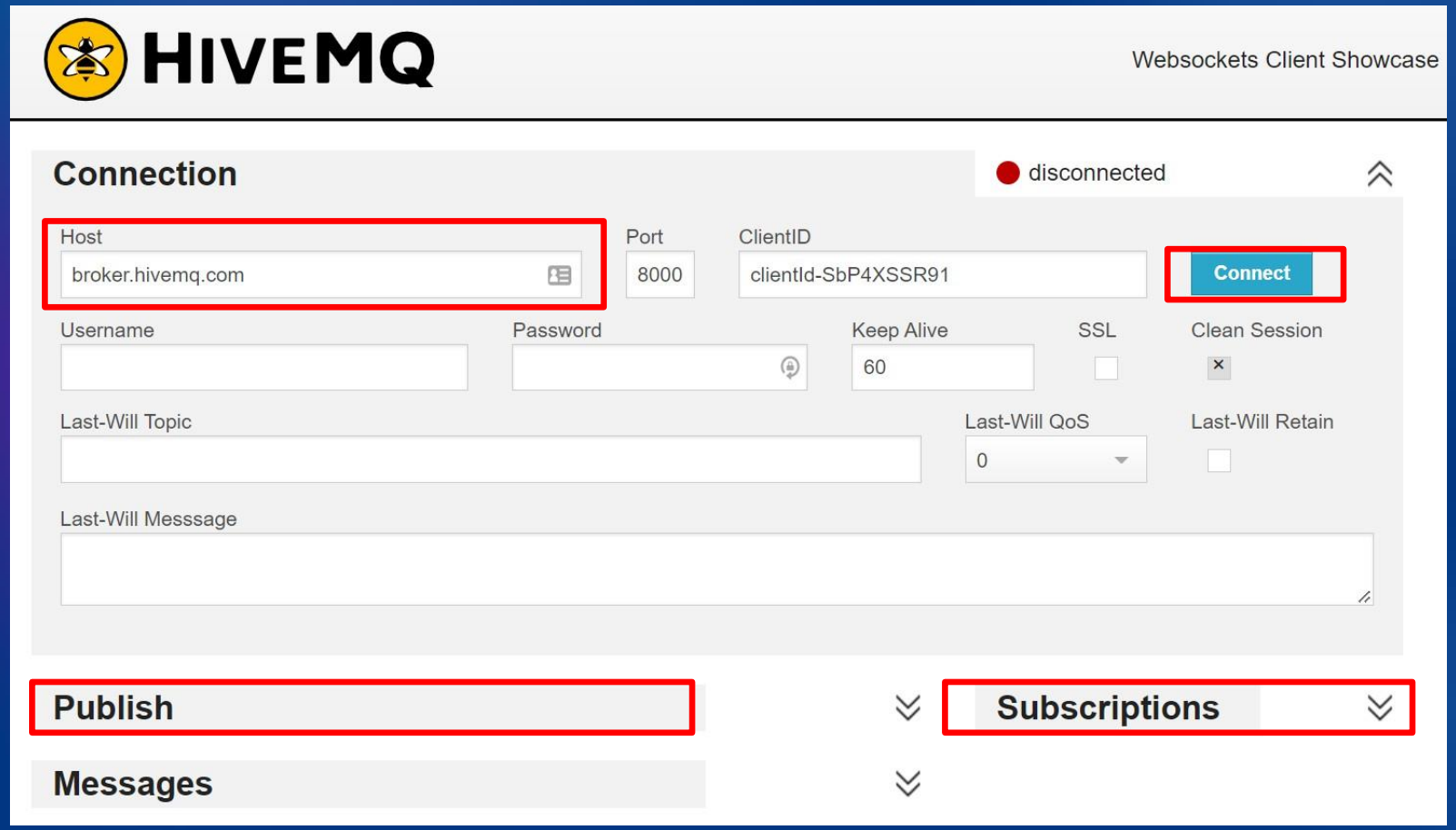
Function	Keterangan
#include "PubSubClient.h"	Library ini untuk mengkoneksikan ESP32 ke MQTT broker
PubSubClient mqttClient()	Membuat object “mqttClient”
mqttClient.setServer(mqttServer, mqttPort)	Setting alamat target dan port broker
mqttClient.setCallback()	Untuk dapat menerima pesan balikan dari server
mqttClient.connected()	Mengembalikan nilai True jika berhasil terkoneksi dan False jika belum
mqttClient.connect(clientID)	Untuk dapat terhubung dengan broker (ClientID harus unique) dan memiliki keluaran Boolean
mqttClient.publish(topic, payload)	Untuk melakukan publish ke suatu topic (Payload berupa String)
mqttClient.subscribe(topik)	Untuk berlangganan suatu topik
client.loop()	Untuk memproses semua penerimaan dan pengiriman pesan yang tersedia untuk klien (client)

MQTT Broker

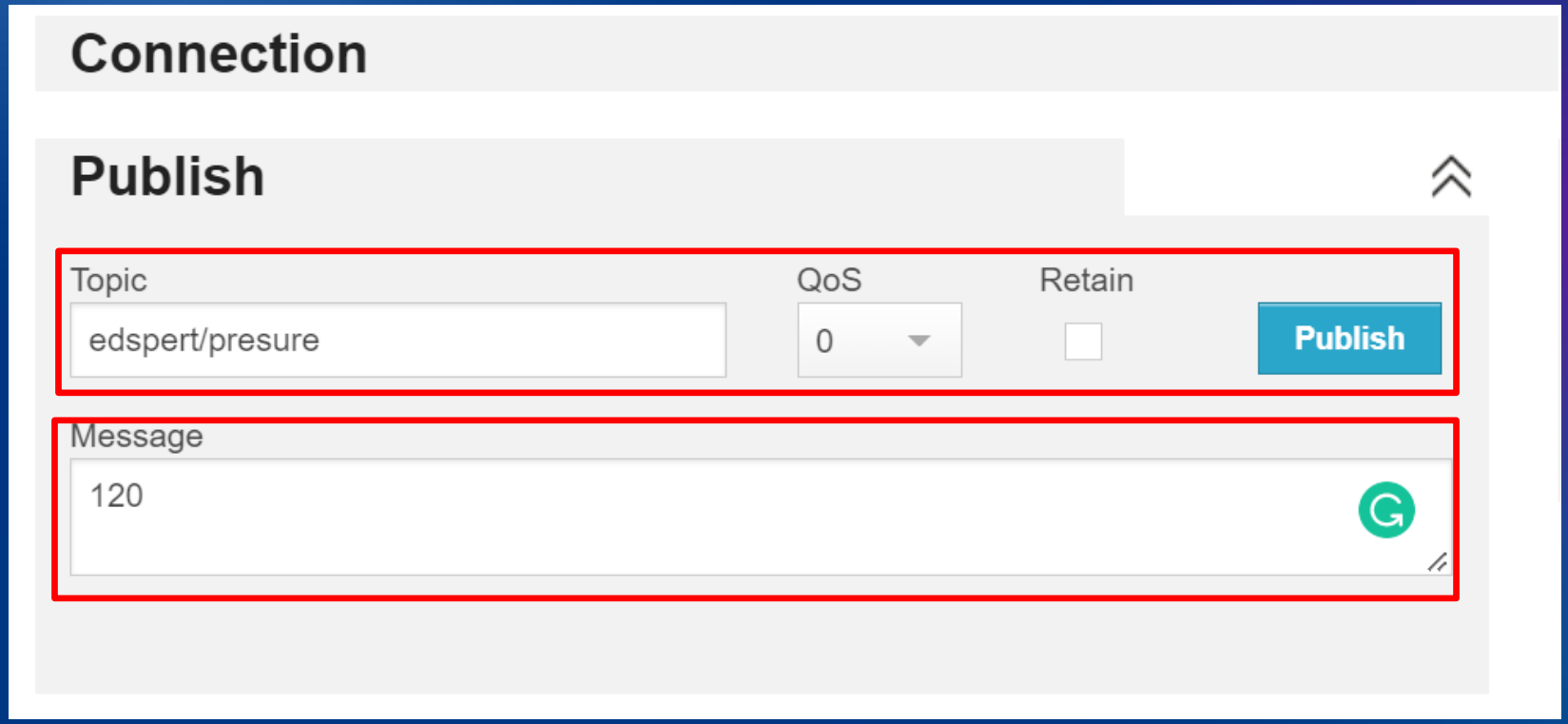


http://www.mqtt-dashboard.com/

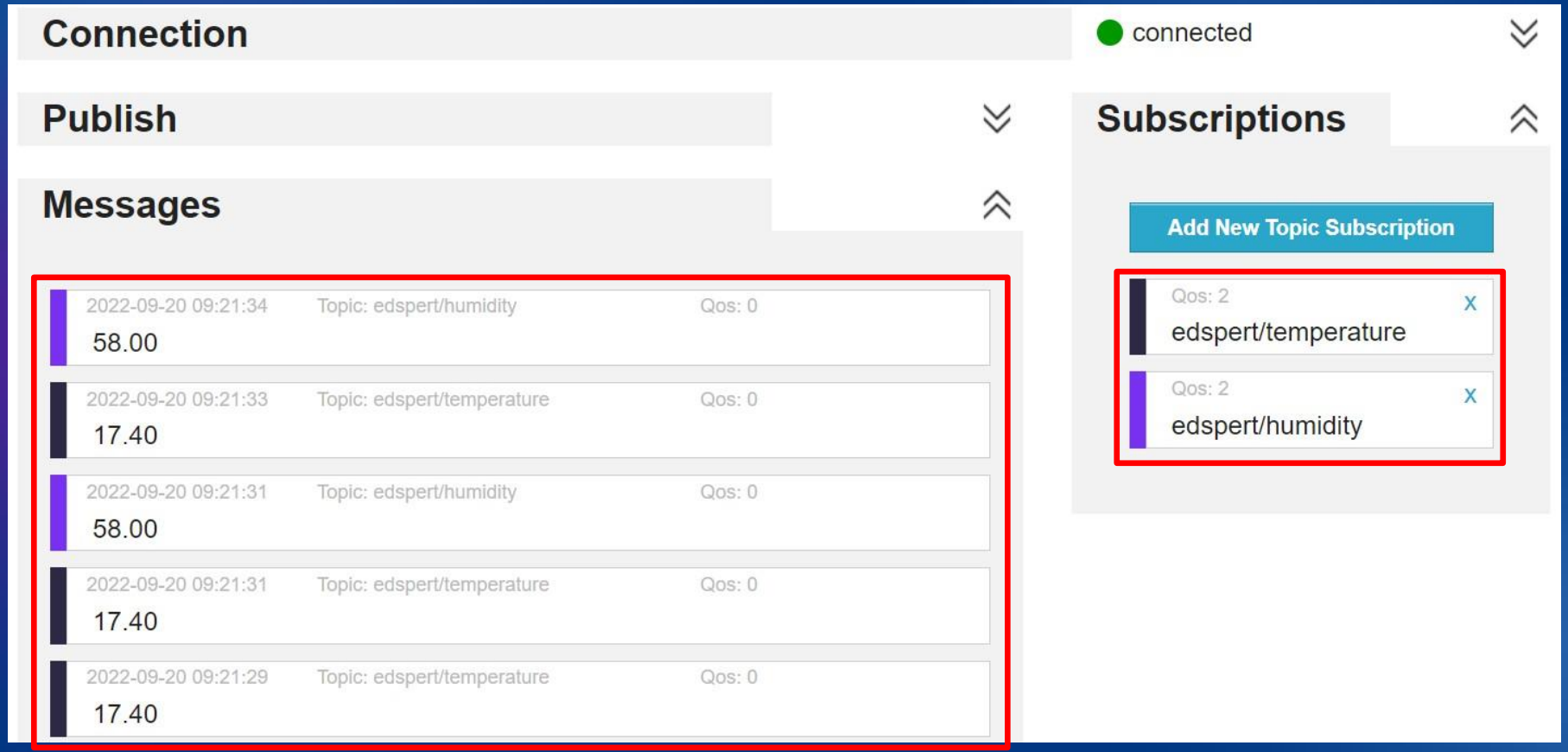
MQTT Client


HIVEMQ
Websockets Client Showcase
Connection
disconnected
Host
broker.hivemq.com
Port
8000
ClientID
clientId-SbP4XSSR91
Connect
Username
Password
Keep Alive
60
SSL
Clean Session
Last-Will Topic
Last-Will QoS
0
Last-Will Retain
Last-Will Messsage
Publish
Subscriptions
Messages

MQTT Publisher



MQTT Subscriber



Wokwi Link

- **Scan Wifi:** https://wokwi.com/projects/356536057700109313
- **Connect to Network:** https://wokwi.com/projects/356552645200576513
- **Send Data To Thingspeak:** https://wokwi.com/projects/356570887769089025
- **Publisher:** https://wokwi.com/projects/356645399959380993
- **Subscriber:** https://wokwi.com/projects/356646013877586945
- **Parsing Data & LED Response:** https://wokwi.com/projects/356666910782912513

More info about IoT

- **Blog:** https://medium.com/@sonyalfathani
- **YouTube:** https://youtu.be/R3v8kGaafHM

Terimakasih...

◉ Mari kita diskusi...