

# IoT Protocol (HTTP & MQTT)

Bootcamp - Menjadi IoT Engineer

Edspert.id

Sony Alfathani [LinkedIn](#)



#jadiExpert

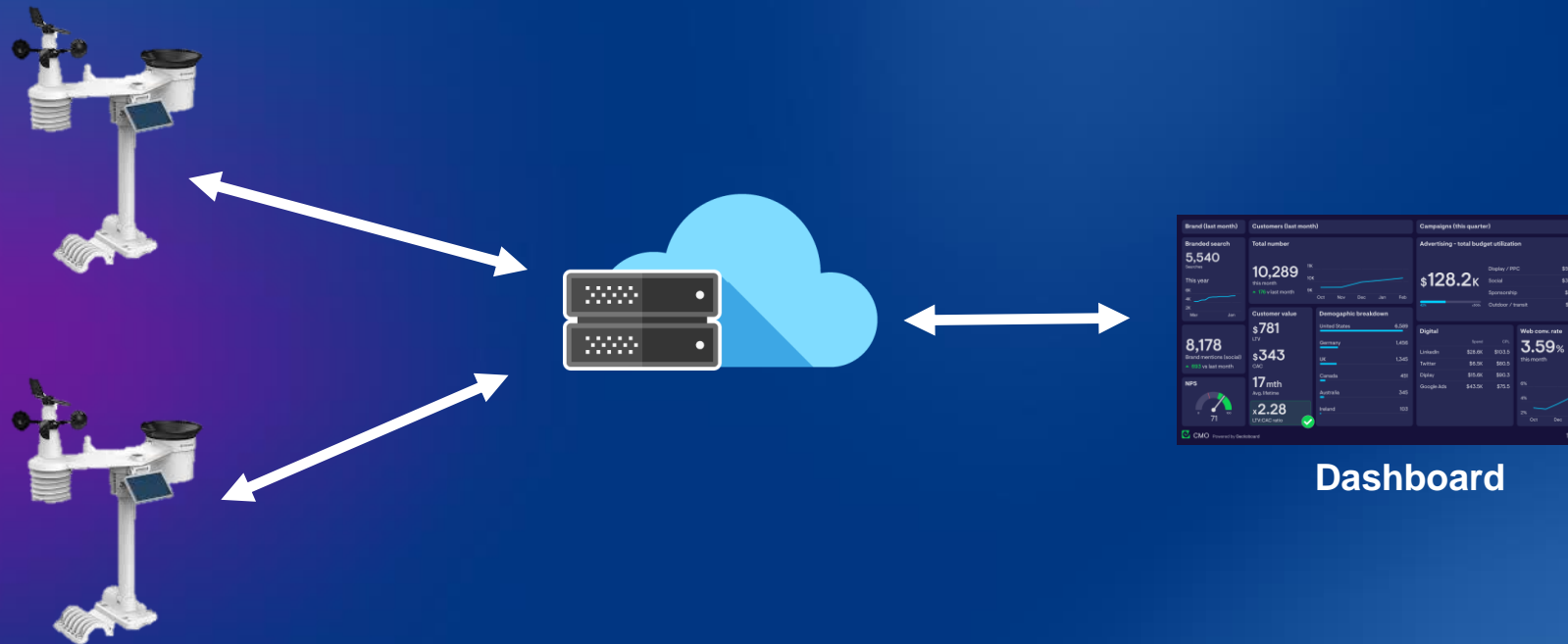
halo@widyædu.com

# Contents

- Apa itu HTTP ?
- HTTP Request-Response
- Apa itu MQTT ?
- Komponen MQTT
- MQTT QoS (Quality of Service)
- Implementasi MQTT



# Sending Data



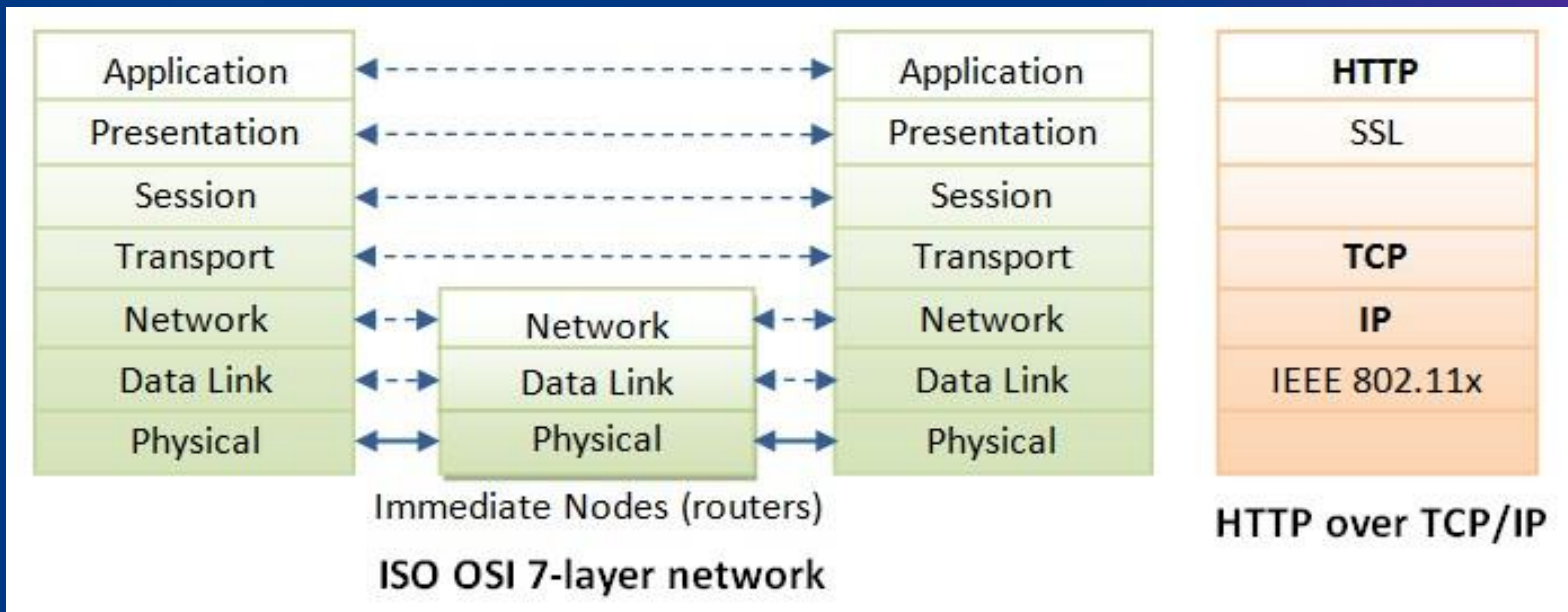
Dashboard

We need a protocol

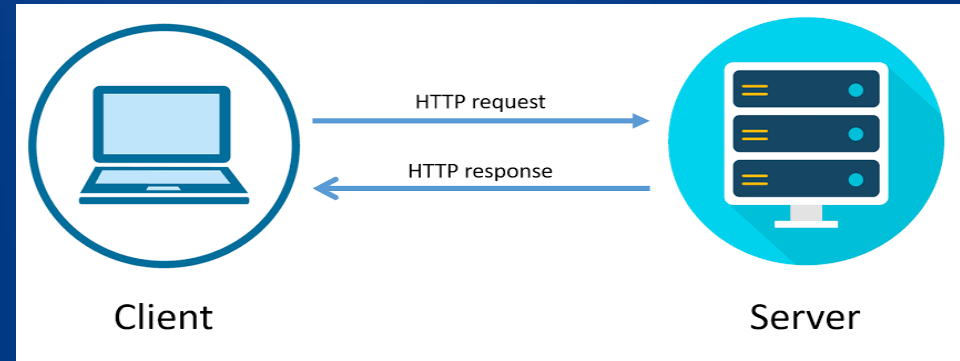


# Apa itu HTTP ?

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)
```

## 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)
```

start-line

HTTP headers

empty line

body

## 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)

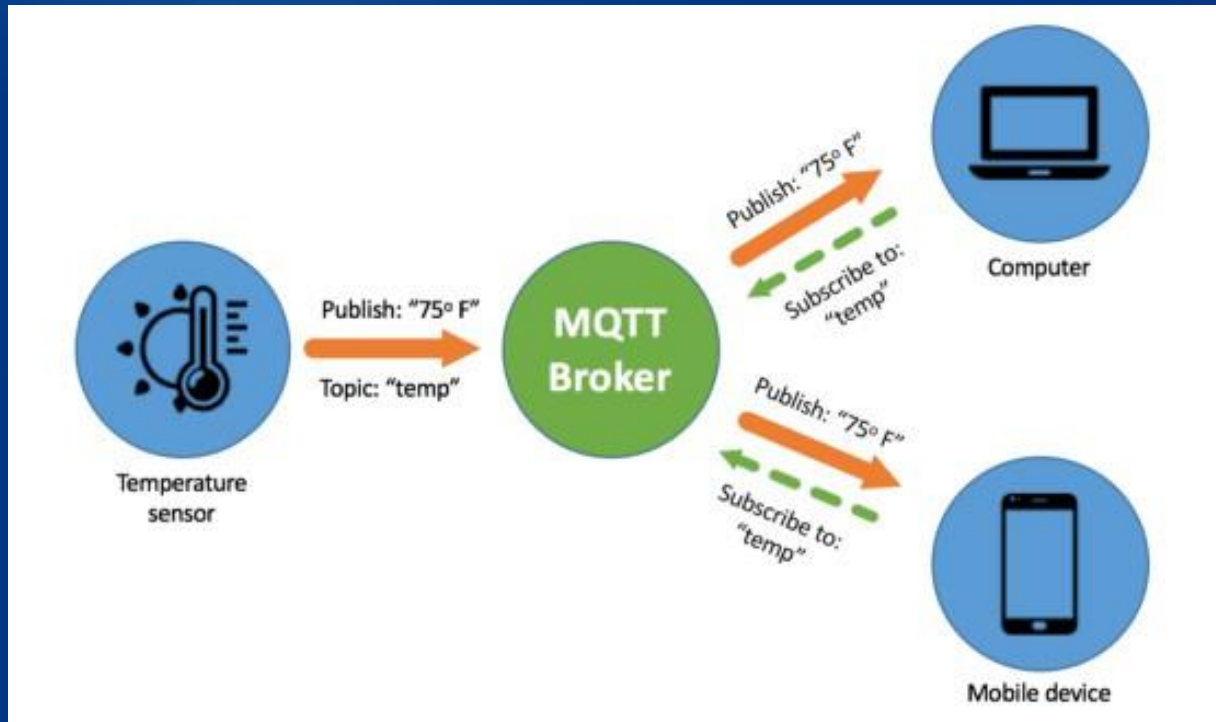
## Struktur HTTP Response

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

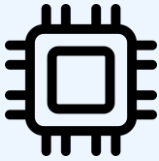


# Apa itu MQTT ?

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.





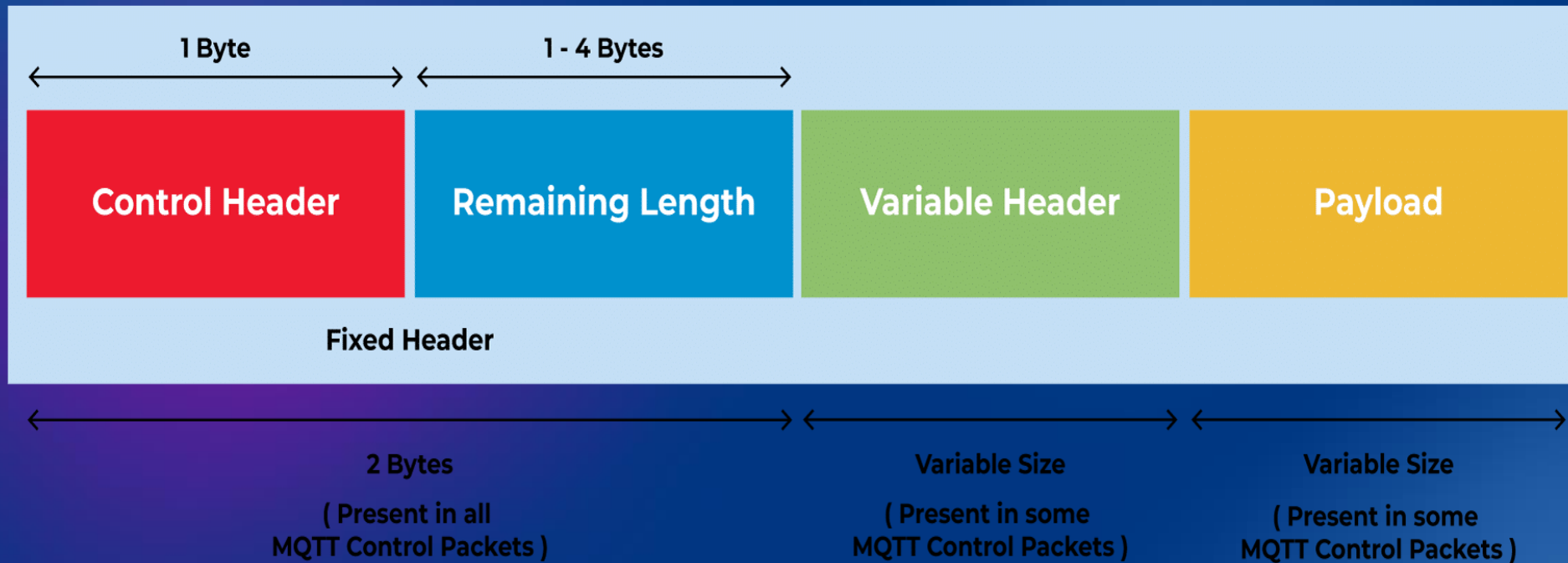
# MQTT QoS

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*.



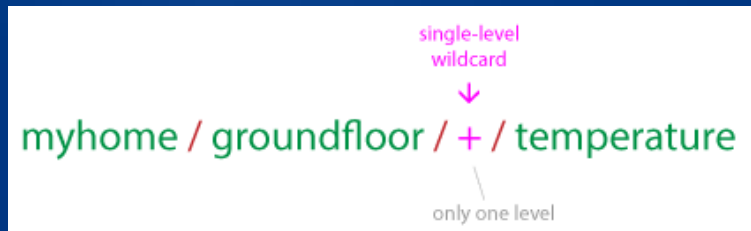
# MQTT Packet Format



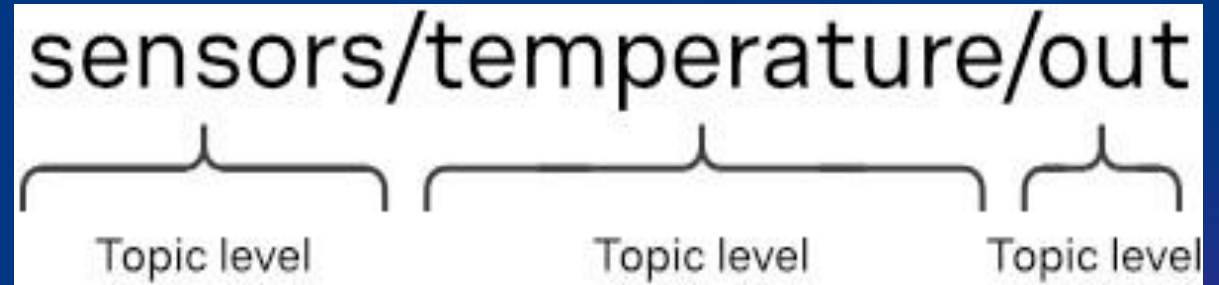
# MQTT Topic

## 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

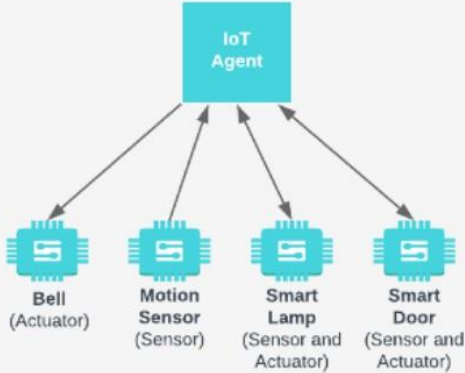
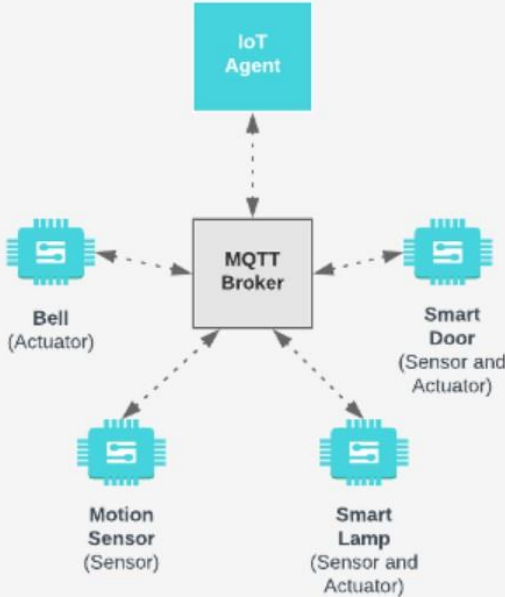


### Multi-level



- ✓ 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 <b>directly</b>	IoT Agent communicates with IoT devices <b>indirectly</b> via an MQTT Broker
<b>Request-Response</b> Paradigm	<b>Publish-Subscribe</b> Paradigm
IoT Devices must always be ready to receive communication	IoT Devices choose when to receive communication
Higher Power Requirement	Low Power Requirement

## MQTT

- Lower bandwidth usage
- Lower latency, higher throughput
- Supports raw binary data

## HTTP

- Lighter weight
- Fewer firewall issues
- Binary data must be base64-encoded

# ESP Connection

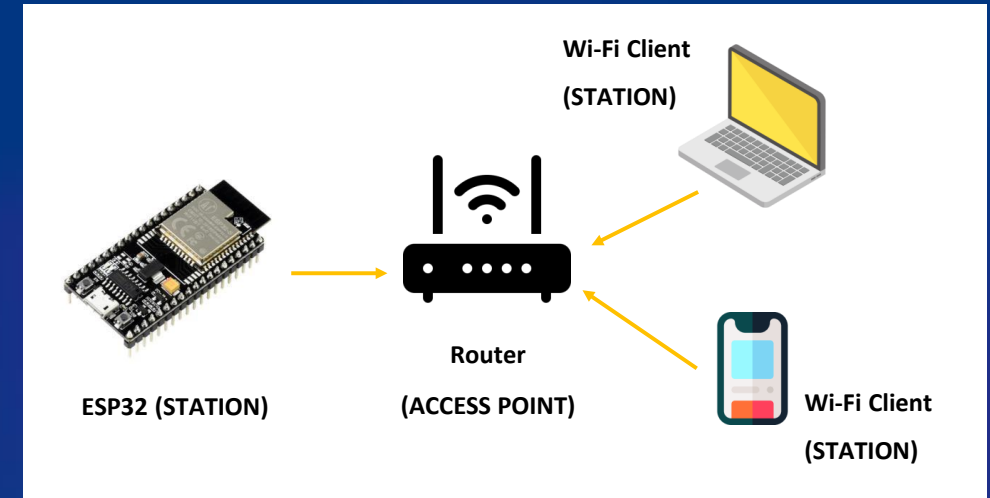
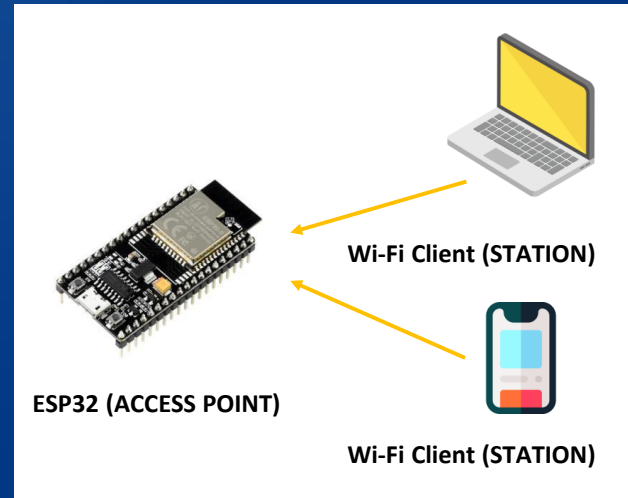


# Wi-Fi Mode

```
#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.

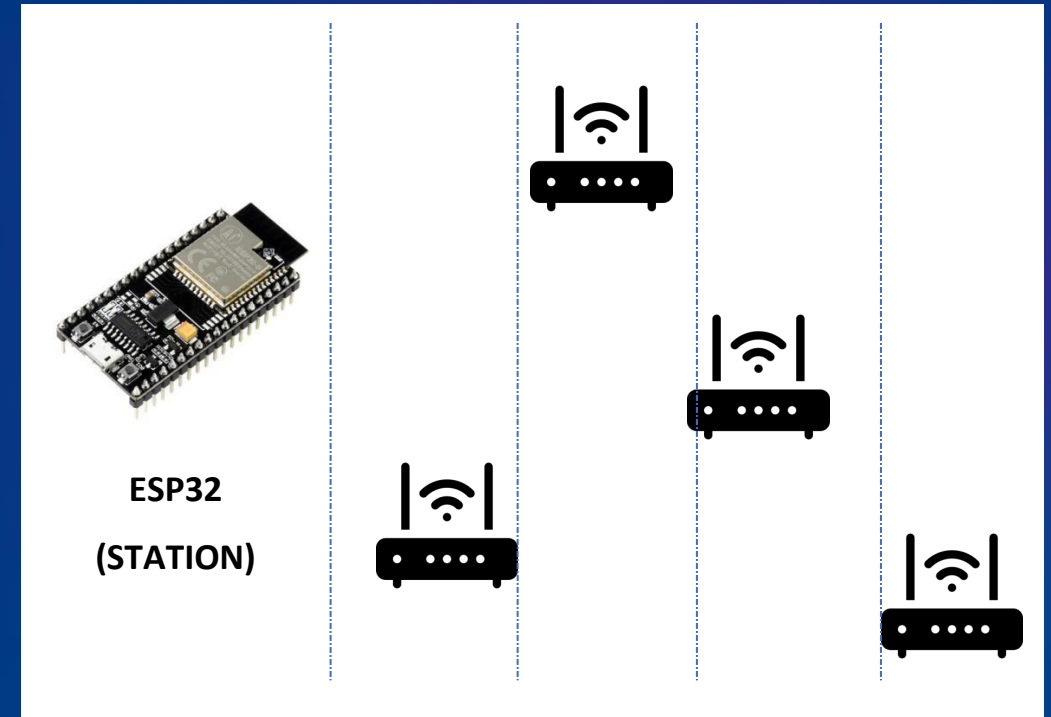
1. **Station Mode (STA)**
2. **Access Point Mode (AP)**
3. **STA & AP Mode**



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

# Scan Wi-Fi Networks

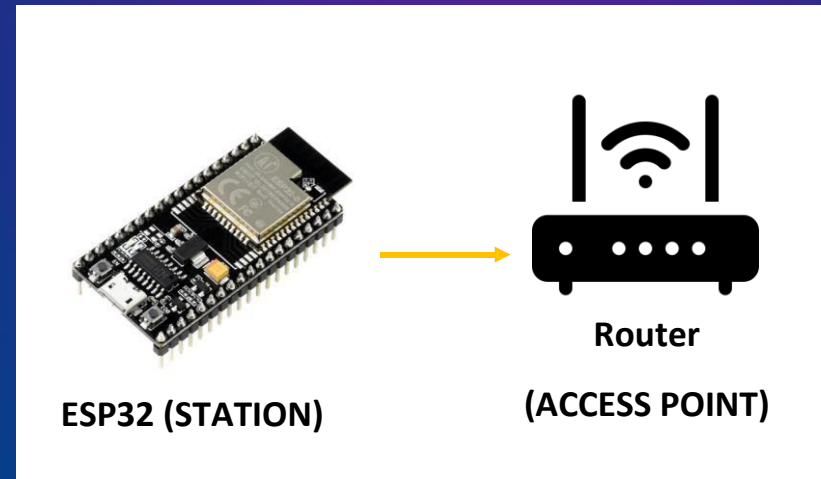
Function	Keterangan
WiFi.scanNetworks()	Akan memberikan nilai balikan jumlah network yang ditemukan
WiFi.SSID(i)	Mendapatkan nama SSID Wifi Network
WiFi.RSSI(i)	Mendapatkan nilai RSSI Wifi Network





## 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



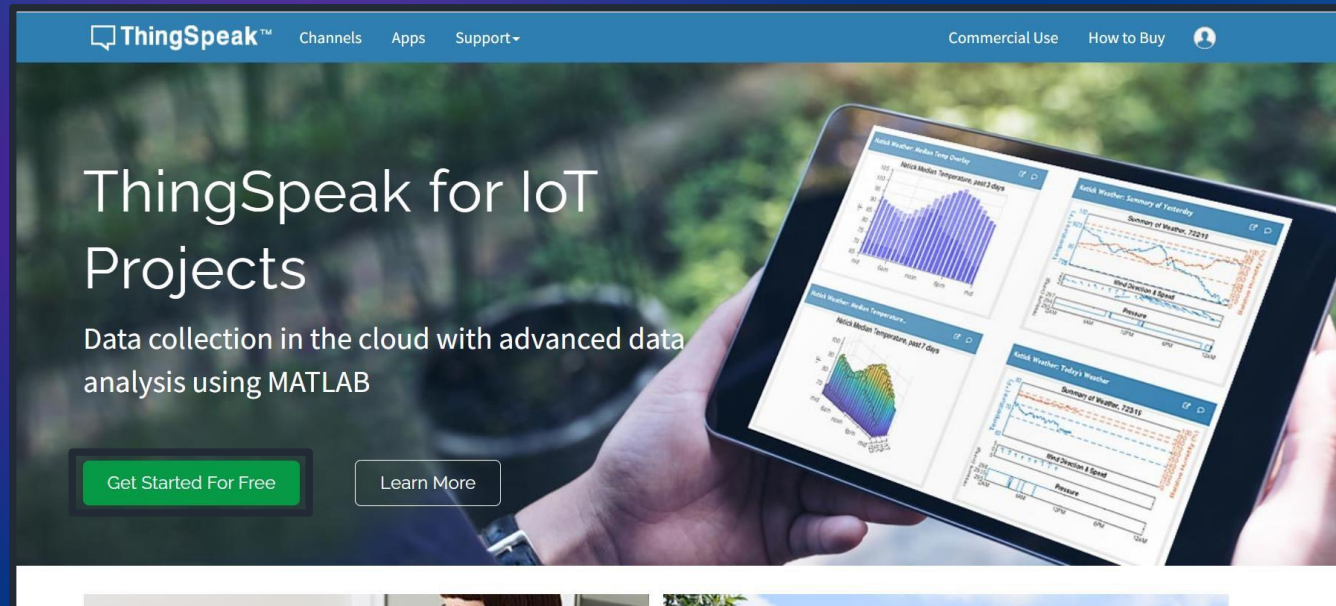


# HTTP Protocol



# 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

To use ThingSpeak, you must sign in with your existing MathWorks account or create a new one.

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.

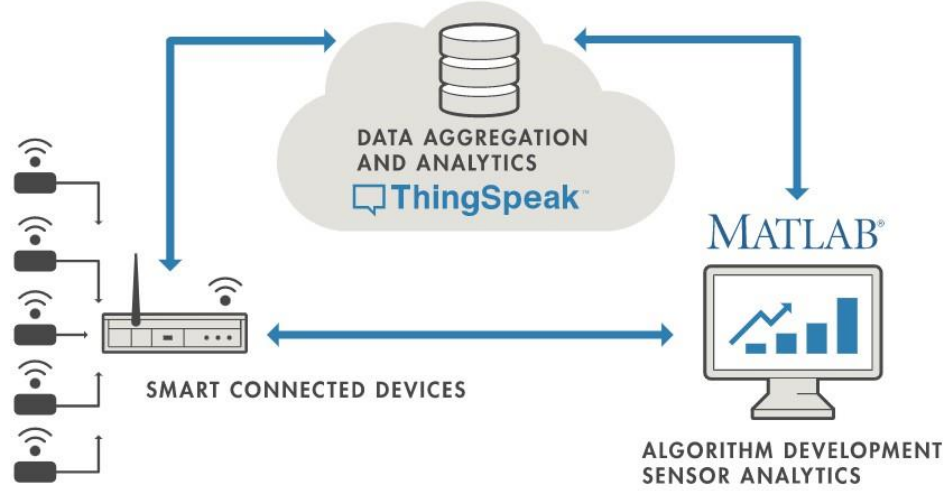


Email


No account? **Create one!**

By signing in, you agree to our [privacy policy](#).

Next



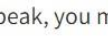
```
graph LR; subgraph "SMART CONNECTED DEVICES"; direction TB; D1[Device 1] --> Gateway[Gateway]; D2[Device 2] --> Gateway; D3[Device 3] --> Gateway; D4[Device 4] --> Gateway; D5[Device 5] --> Gateway; end; Gateway --> Cloud((DATA AGGREGATION AND ANALYTICS  
ThingSpeak™)); Cloud --> MATLAB[ALGORITHM DEVELOPMENT  
SENSOR ANALYTICS  
MATLAB];
```



#jadiExpert

halo@widyædu.com

### 3. Isi semua box data dan klik Continue


[Channels](#)
[Apps](#)
[Support](#)

[Commercial Use](#)
[How to Buy](#)

To use ThingSpeak, you must sign in with your existing MathWorks account or create a new one.

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.

### Create MathWorks Account

**Email Address**

emailanda@gmail.com

**Location**

Tunisia

**First Name**

akun

**Last Name**

coba

Continue

**DATA AGGREGATION AND ANALYTICS**

**ThingSpeak**

**MATLAB**

**ALGORITHM DEVELOPMENT**

**SENSOR ANALYTICS**

**SMART CONNECTED DEVICES**

## 4. Isi Email anda, Check list dan klik Continue

ThingSpeak™ Channels Apps Support

Commercial Use How to Buy

To use ThingSpeak, you must sign in with your existing MathWorks account or create a new one.

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.

### Personal Email Detected

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

Email Address

☒ Use this email for my MathWorks Account

Continue

Cancel

This site is protected by reCAPTCHA Enterprise and the Google Privacy Policy and Terms of Service apply.

```
graph LR; subgraph "SMART CONNECTED DEVICES"; direction TB; D1[Device 1]; D2[Device 2]; D3[Device 3]; D4[Device 4]; D5[Device 5]; D6[Router]; end; subgraph "DATA AGGREGATION AND ANALYTICS ThingSpeak™"; direction TB; Cloud((Cloud)); end; subgraph "MATLAB® ALGORITHM DEVELOPMENT SENSOR ANALYTICS"; direction TB; Monitor[Monitor]; end; D1 --> Cloud; D2 --> Cloud; D3 --> Cloud; D4 --> Cloud; D5 --> Cloud; D6 --> Cloud; Cloud --> Monitor;
```



## 5. Verify akun melalui email anda

ThingSpeak™

Channels

Apps

Support

Commercial Use

How to Buy

To use ThingSpeak, you must sign in with your existing MathWorks account or create a new one.

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.

### Verify Your MathWorks Account

To finish creating your account, complete the following steps:

1. Go to your inbox for **emailsasasa@gmail.com**.
2. Click the link in the email we sent you.
3. Click **Continue**.

### Didn't receive the email?

- Check your spam folder.
- Send me the email again.
- If you still have not received the email, Contact [Customer Support](#)

Continue

```
graph LR; subgraph Devices [SMART CONNECTED DEVICES]; D1[Device 1]; D2[Device 2]; D3[Device 3]; D4[Device 4]; D5[Device 5]; end; subgraph Cloud [DATA AGGREGATION AND ANALYTICS]; TS[ThingSpeak]; end; subgraph MATLAB [MATLAB]; subgraph Analytics [ALGORITHM DEVELOPMENT SENSOR ANALYTICS]; M1[Monitor]; end; end; D1 --> Cloud; D2 --> Cloud; D3 --> Cloud; D4 --> Cloud; D5 --> Cloud; Cloud --> MATLAB;
```

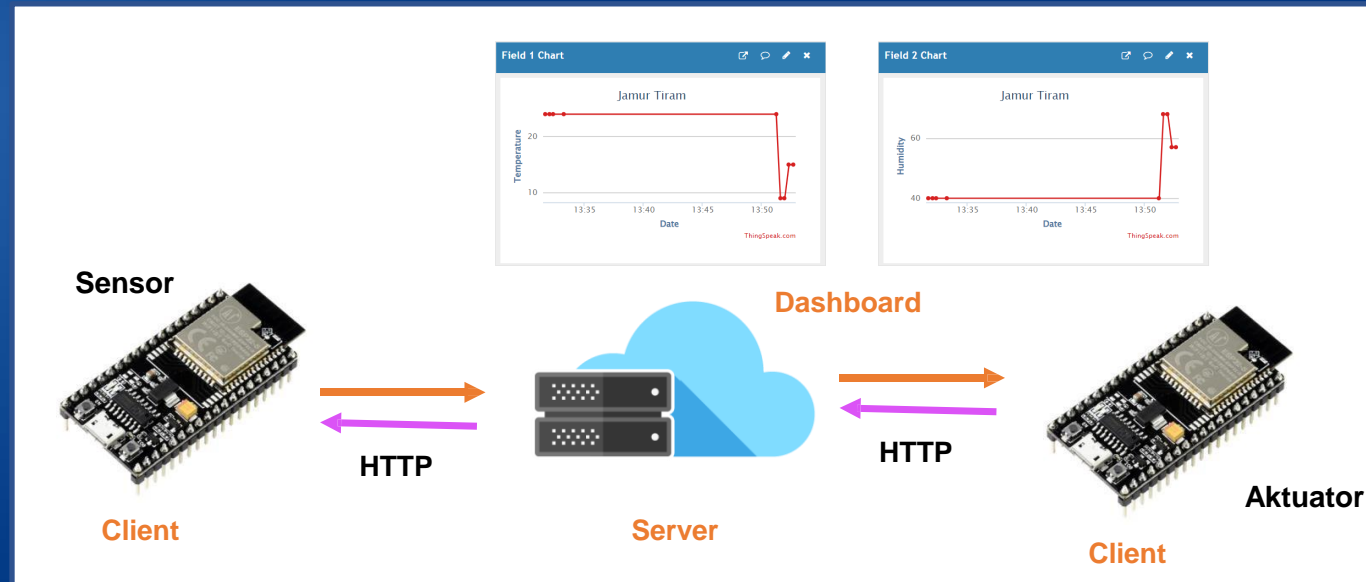
MathWorks

---

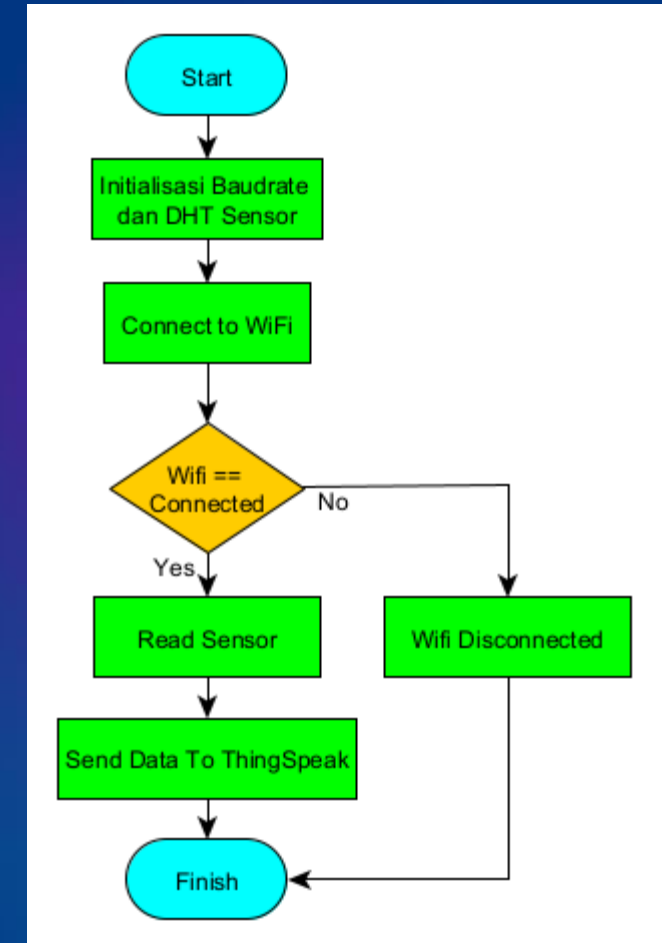
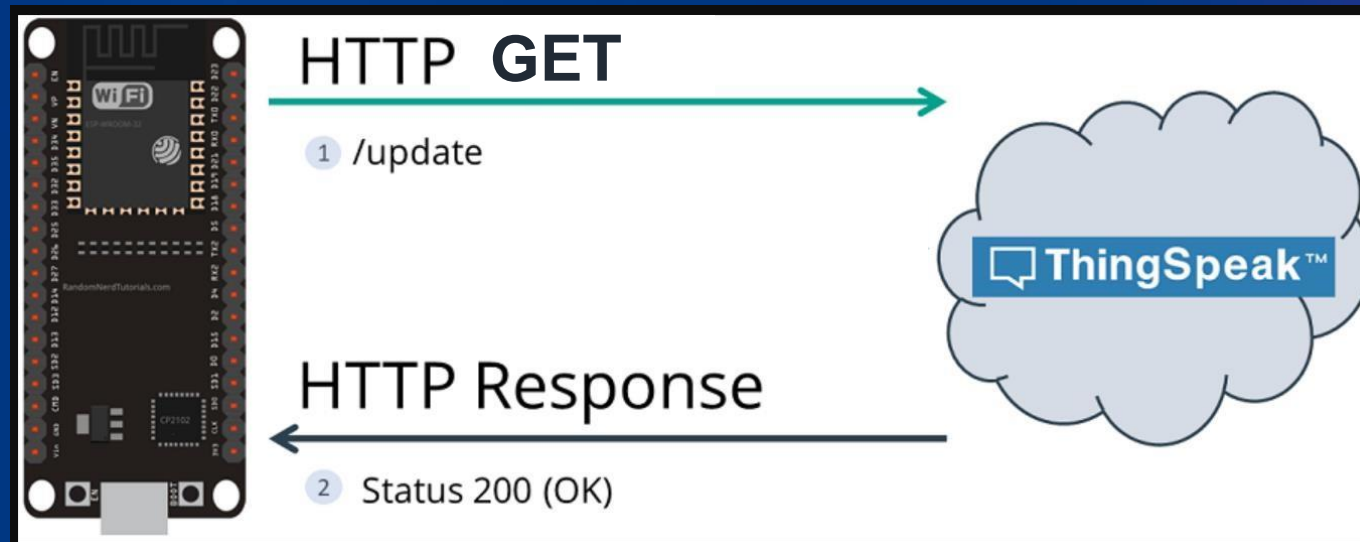
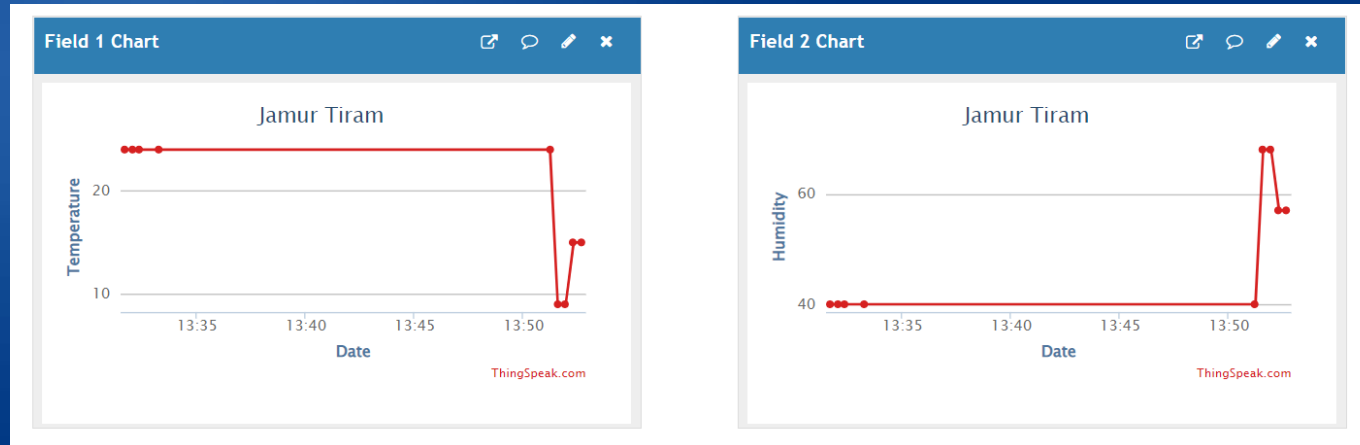
### Welcome to MathWorks!

To complete your MathWorks Account setup, click **Verify email**.

Verify email



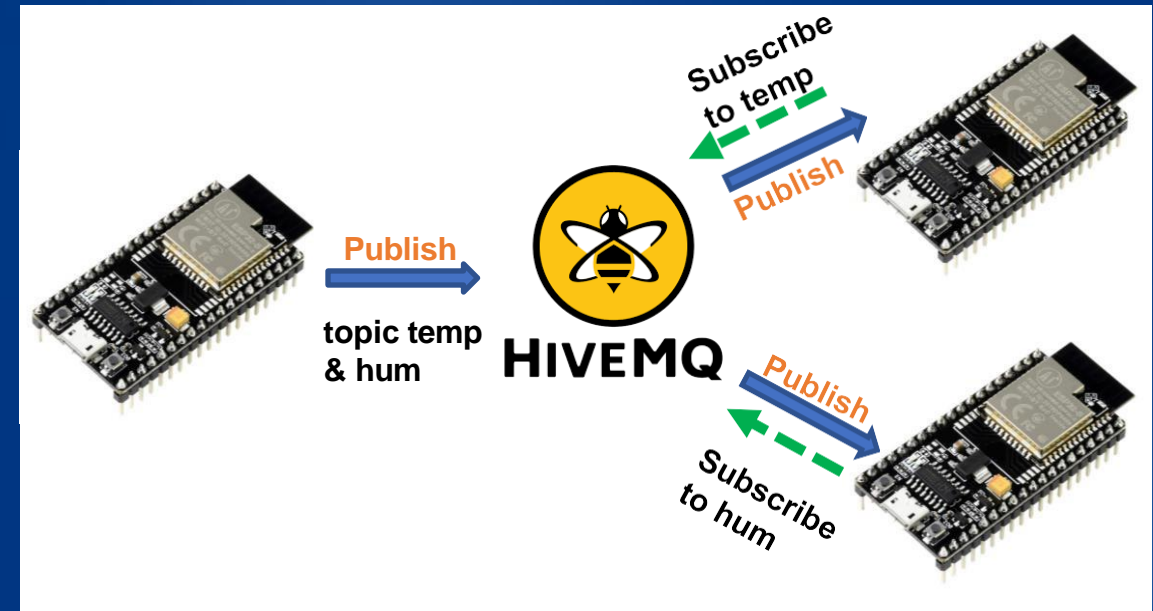
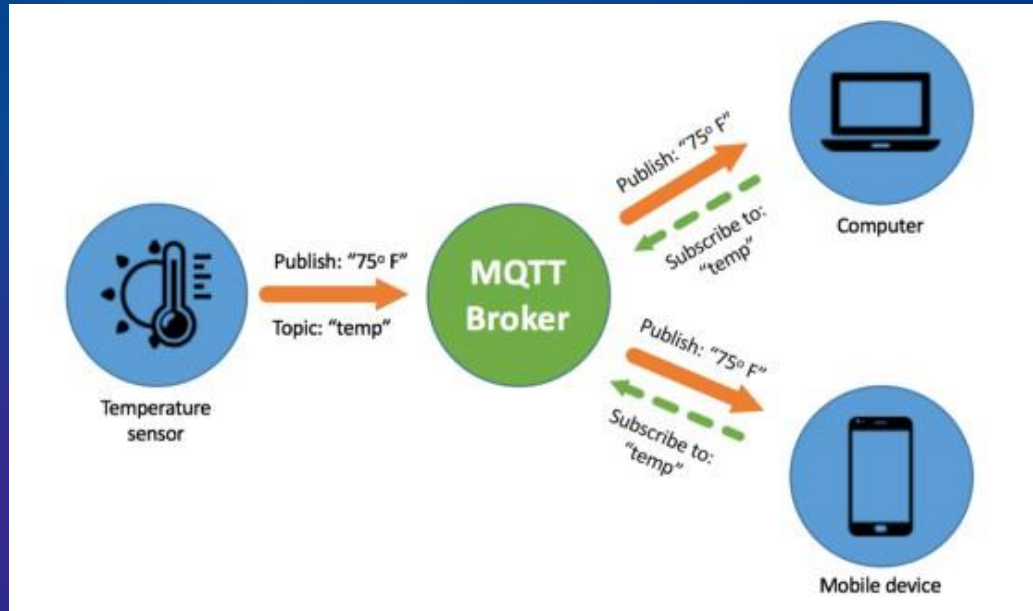
Function	Keterangan
<code>#include &lt;HTTPClient.h&gt;</code>	Panggil library HTTPClient yang menyediakan banyak metode yang akan membantu kita bekerja dengan fungsionalitas HTTP
<code>HTTPClient httpku</code>	Membuat suatu object "httpku"
<code>httpku.begin()</code>	Mendefinisikan Spesific URL tujuan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





# MQTT Protocol





# Connect to Wi-Fi Networks

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



# MQTT Broker

The screenshot shows the HiveMQ MQTT Dashboard. The top navigation bar includes the HiveMQ logo, the text 'HIVEMQ', and links for 'Home' and 'Legal'. The main header displays 'HiveMQ | Public Broker | MQTT Dashboard' and a status indicator for 'HiveMQ cluster ( 3 nodes )'. The dashboard is divided into several sections:

- Broker:** Contains introductory text about the MQTT Dashboard, testing and usage policies, and information about the free HiveMQ Cloud platform.
- Getting Started:** Provides links to 'MQTT Essentials' and 'MQTT Websocket client' (highlighted with a red box), and mentions the 'MQTT Client Library Encyclopedia'.
- Metrics:** A row of four boxes showing 'Outgoing Messages' (1012615295), 'Incoming Messages' (1660893880), 'Subscriptions' (194011), and 'Retained Messages' (32374).
- Clients:** A section with a circular gauge chart.
- MQTT connection settings:** A box (highlighted with a red border) containing connection details: Host: broker.hivemq.com, TCP Port: 1883, and Websocket Port: 8000.

A sidebar on the left promotes 'HIVEMQ CLOUD' and mentions that the basic version is now free for up to 100 MQTT clients, with a 'Learn more' button.


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



#jadiExpert

halo@widyaeu.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 Message

Publish

Subscriptions

Messages

# MQTT Publisher

## Connection

## Publish

Topic

edsper/presure

QoS

0


Retain

☐

Publish

Message

120



# MQTT Subscriber

The screenshot displays an MQTT client interface with the following components:

- Connection:** Status is "connected" (indicated by a green dot).
- Publish:** A section for sending messages, currently empty.
- Messages:** A list of received messages, highlighted with a red box. The messages are as follows:

Timestamp	Topic	Qos	Message
2022-09-20 09:21:34	edspert/humidity	0	58.00
2022-09-20 09:21:33	edspert/temperature	0	17.40
2022-09-20 09:21:31	edspert/humidity	0	58.00
2022-09-20 09:21:31	edspert/temperature	0	17.40
2022-09-20 09:21:29	edspert/temperature	0	17.40
- Subscriptions:** A list of active subscriptions, highlighted with a red box. The subscriptions are:

Qos	Topic	Action
2	edspert/temperature	X
2	edspert/humidity	X



# 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...

