

# **Production Supporting Systems in Factories**

**ระบบสนับสนุนการผลิตในโรงงานอุตสาหกรรม**

# MQTT

# MQTT

- MQTT is a Client Server publish/subscribe messaging transport protocol.
- It is light weight, open, simple, and designed so as to be easy to implement.
- Ideal for use in many situations
  - Machine to Machine (M2M)
  - **Internet of Things (IoT)**

# Publish/subscribe pattern

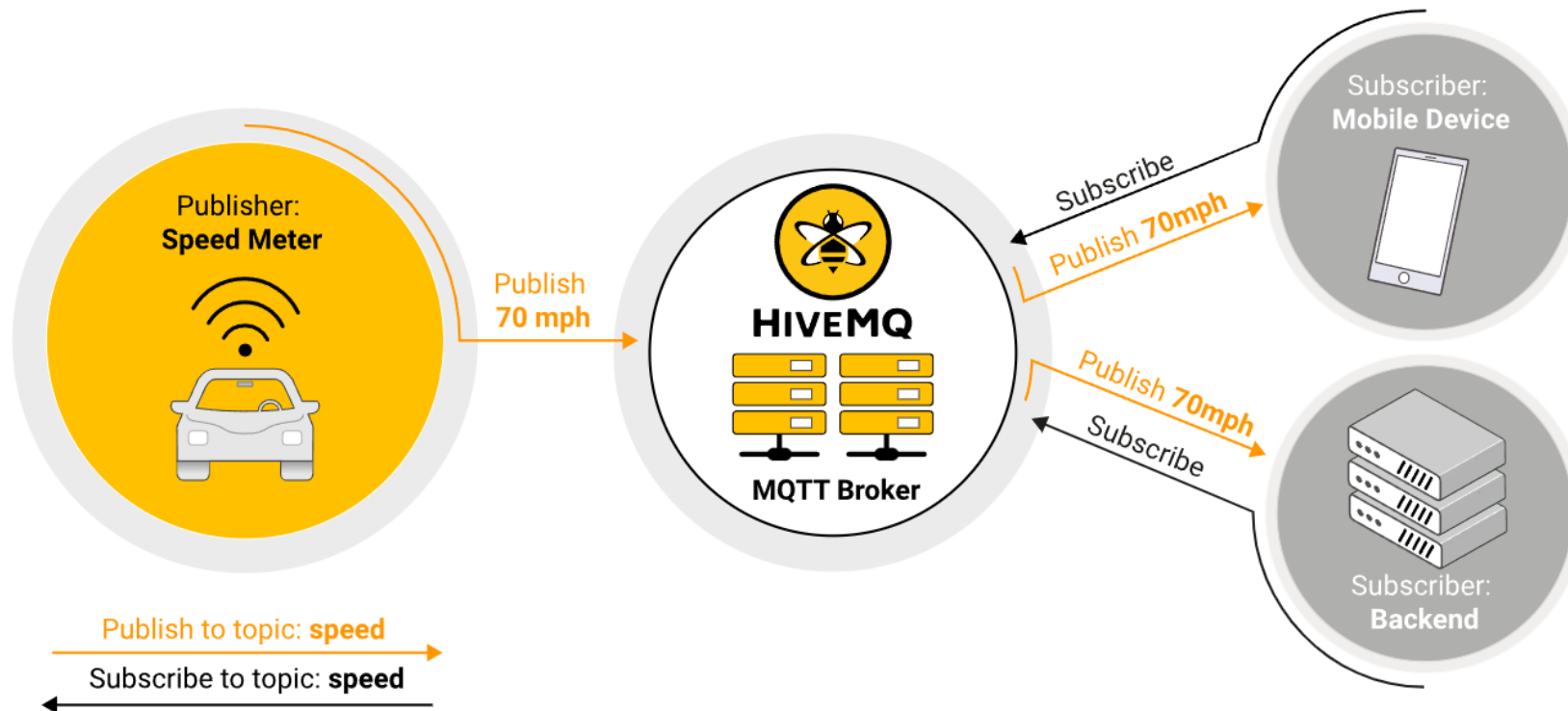
- The publish/subscribe pattern (also known as `pub/sub`) provides an **alternative** to traditional client-server architecture.
  - In client-server architecture, a client communicates directly with an endpoint.

# Publishers and subscribers

- The `pub/sub` model decouples
  - a client that sends a message (the `publisher`) from
  - a client or clients that receive the messages (the `subscribers`).
- The `publishers` and `subscribers` never contact each other directly.
  - In fact, they are not even **aware that the other exists**.

# Broker

- The connection between `publishers` and `subscribers` is handled by a third component (the `broker`).
- The job of the broker is to filter all incoming messages and distribute them correctly to subscribers.



# Aspects of pub/sub architecture

- **Space decoupling:** Publisher and subscriber do not need to know each other (for example, no exchange of IP address and port)
- **Time decoupling:** Publisher and subscriber do not need to run at the same time.
- **Synchronization decoupling:** Operations on both components do not need to be interrupted during publishing or receiving.



# Topic

- **Topic** refers to an UTF-8 string that the broker uses to filter messages for each connected client.
- The topic consists of one or more topic levels. Each topic level is separated by a forward slash (topic level separator).



# Topic examples

- Each topic must contain at least 1 character.
  - Actually, `/` is a topic.
- Topic string permits empty spaces.
  - `USA/California/San Francisco/Silicon Valley` is a valid topic.
- Topics are case-sensitive.
  - `myhome/temperature` and `MyHome/Temperature` are two different topics.

- Wildcards

single-level  
wildcard  
↓  
myhome / groundfloor / + / temperature  
|  
only one level

- ✓ myhome / groundfloor / livingroom / temperature
- ✓ myhome / groundfloor / kitchen / temperature
- ✗ myhome / groundfloor / kitchen / brightness
- ✗ myhome / firstfloor / kitchen / temperature
- ✗ myhome / groundfloor / kitchen / fridge / temperature

multi-level  
wildcard  
↓  
myhome / groundfloor / #

only at the end  
multiple topic levels

- ✓ myhome / groundfloor / livingroom / temperature
- ✓ myhome / groundfloor / kitchen / temperature
- ✓ myhome / groundfloor / kitchen / brightness
- ✗ myhome / firstfloor / kitchen / temperature

**Enough talk. Let's try it.**

# MQTT Terminal (Android)

- Broker URL/IP :  
1.tcp.ap.ngrok.io
- Client ID : อะไรก็ได้ที่ไม่ซ้ำ
- Port : 25580
- Publish Topic : test/main
- Subscribe Topic : test/main

8:41 87%

← Edit Server

Connection Name  
prodsup **Change**

Client ID  
my-id

Broker URL / IP  
**Broker URL**

Port  
1883

☐ SSL ☐ Web Socket

Enable user authentication ☐

Publish Topic  
test/main

☒ QoS 0 ☐ QoS 1 ☐ QoS 2

☐ Retained


Subscribe Topic  
test/main

☒ QoS 0 ☐ QoS 1 ☐ QoS 2

Cancel Change

# MQTTool (iOS)

- Host : 1.tcp.ap.ngrok.io
- Port : 25580
- Client ID : Leave blank

Host:  

Port:  Clean Session: ☒

Client Id:

Leave blank for unauthenticated access

Username:

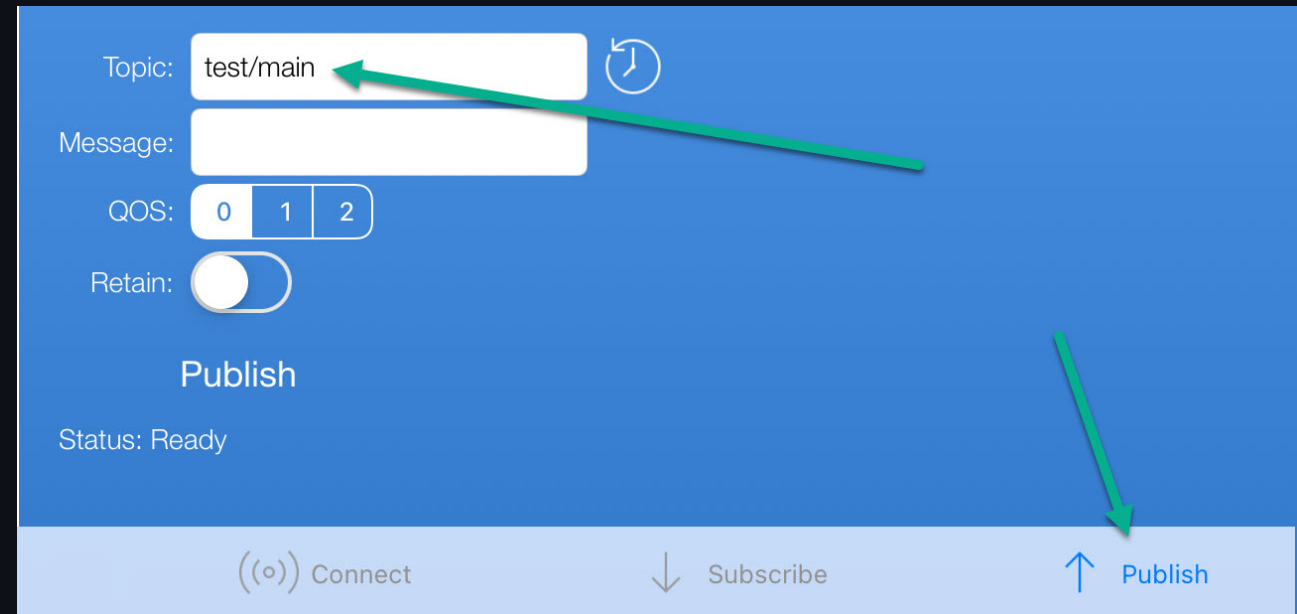
Password:

Disconnect ☐ Save Password ☐

Status: Connected to 35.240.248.118:1883

Click 15

- `topic: test/main`



The image shows a screenshot of an MQTT client interface. It has a blue background with white text and input fields. At the top, there's a 'Topic:' label followed by a text input field containing 'test/main'. To the right of this field is a circular refresh icon. Below the topic field is a 'Message:' label followed by a larger text input field. Underneath the message field are three buttons for 'QOS' with values '0', '1', and '2'. Below the QOS buttons is a 'Retain:' label followed by a toggle switch. A 'Publish' button is located below the Retain toggle. At the bottom of the interface, there's a status bar with three options: '((o)) Connect', '↓ Subscribe', and '↑ Publish'. Two green arrows are overlaid on the image: one points from the right towards the 'test/main' text in the Topic field, and the other points from the right towards the '↑ Publish' button.

Topic: test/main

Message:

QOS: 0 1 2

Retain: ☐

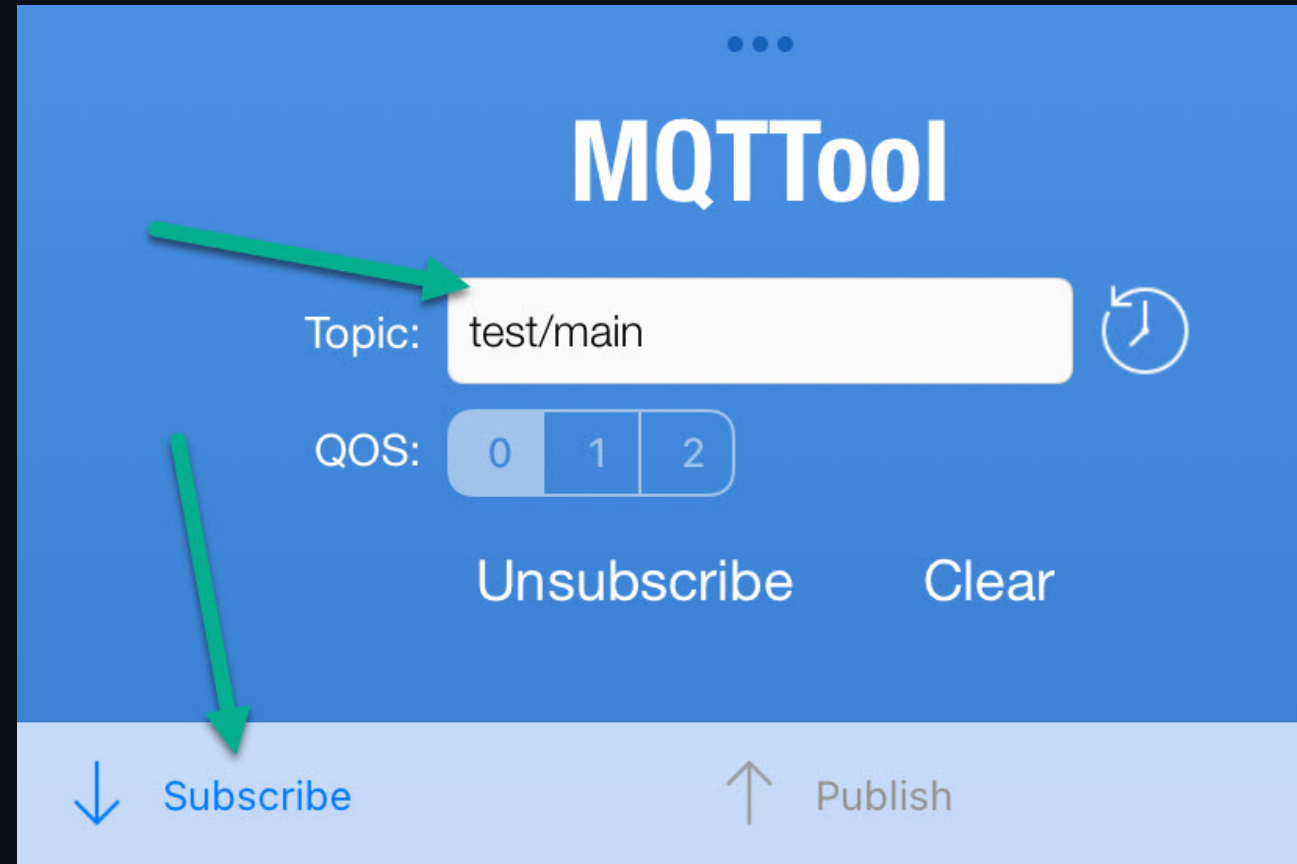
Publish

Status: Ready

((o)) Connect    ↓ Subscribe    ↑ Publish



- `topic: test/main`



The image shows the MQTTTool interface. At the top, there are three blue dots. Below them is the title "MQTTool" in white. A green arrow points to the "Topic:" label, and another green arrow points to the "Subscribe" button. The "Topic:" label is followed by a text input field containing "test/main". To the right of the input field is a circular icon with a clock. Below the input field is a "QOS:" label followed by three buttons labeled "0", "1", and "2". Below the QOS buttons are two buttons labeled "Unsubscribe" and "Clear". At the bottom, there is a light blue bar containing a blue downward arrow and the word "Subscribe", and a gray upward arrow and the word "Publish".

MQTTool

Topic: test/main

QOS: 0 1 2

Unsubscribe Clear

↓ Subscribe ↑ Publish

# Quality of service

- The Quality of Service ( `QoS` ) level is the guarantee of delivery for a specific message.

# Levels of QoS

- **0: At most once**
  - No guarantee of delivery (fire and forget)
  - Fastest
- **1: At least once**
  - Guarantees that a message is *delivered at least one time* to the receiver.
  - Multiple delivery can occur.
- **2: Exactly once**
  - Each message is *received only once* by the intended recipients.
  - Slowest

# Setting QoS level

There are the two sides of message delivery:

- publishing client → broker
- broker → subscribing client

**publishing client** → **broker**

- The **publishing client** defines the **QoS** level of the message.

## broker → subscribing client

- The broker transmits the message to subscribing clients using the QoS level that each subscribing client defines during the subscription process.
- If the subscribing client defines a lower QoS than the publishing client
  - the broker transmits the message with the lower quality of service.

## General use for QoS level

- 0: You don't mind if a few messages are lost occasionally.
- 1: You need to get every message and your use case can handle duplicates.
  - *Generally recommended.*
- 2: It is critical to your application to receive all messages exactly once.

# Retained message

- A retained message is a normal MQTT message with the `retained` flag set to `true`.
- The broker stores the last retained message and the corresponding QoS for that topic.
- Each client that subscribes to a topic pattern that matches the topic of the retained message receives the retained message immediately after they subscribe.
- The broker stores only one retained message per topic.

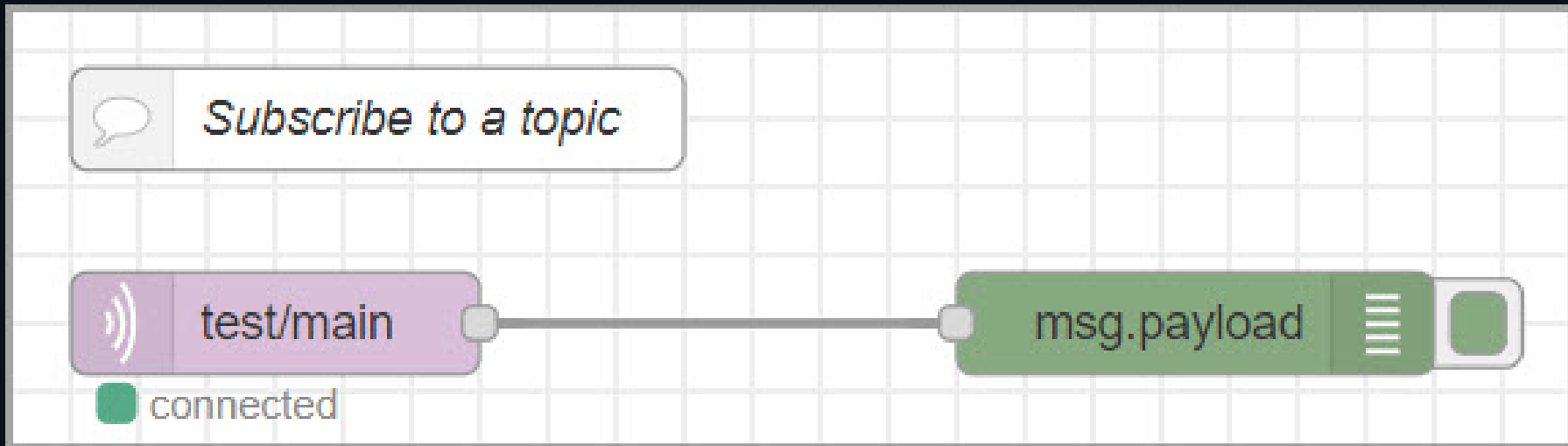


# MQTT in Node-Red

# Subscribe to a topic

- Flow

- mqtt in, debug



- mqtt in node
  - Choose Add new mqtt-broker...
  - Click edit (Next page)
  - Topic : test/main
  - QoS : 1

Edit mqtt in node

Delete Cancel Done

⚙ Properties

🌐 Server ProdSup


Action ProdSup  
Add new mqtt-broker...

📄 Topic test/main

⚙ QoS 1

➡ Output auto-detect (string or buffer)

🏷 Name Name



- Server : 1.tcp.ap.ngrok.io
- Port : 25580

Edit mqtt in node > Add new mqtt-broker config node

Cancel Add

⚙ Properties

🔖 Name ProdSup2

Connection Security Messages

🌐 Server Broker URL Port

☒ Connect automatically

☐ Use TLS

⚙ Protocol MQTT V3.1.1

🔖 Client ID Leave blank for auto generated

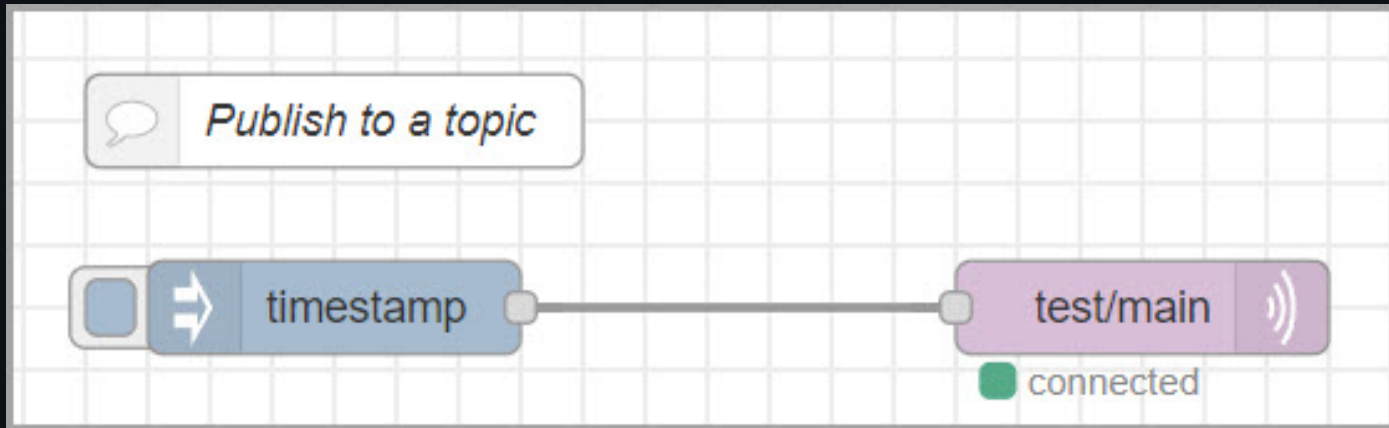
💓 Keep Alive 60

📄 Session ☒ Use clean session

PORT

# Publish to a topic

- Flow
  - inject, mqtt out



- mqtt out
  - Topic: test/main
  - QoS: 1
  - You may choose to Retain message.

### Edit mqtt out node

Delete Cancel Done

#### Properties

Server: ProdSup2

Topic: test/main

QoS: 1 Retain: true

Name: Name

Tip: Leave topic, qos or retain blank if you want to set them via msg properties.