# Introduction To


Embedded Real-Time Systems Lab
Indian Institute of Technology Bombay

IIT Bombay
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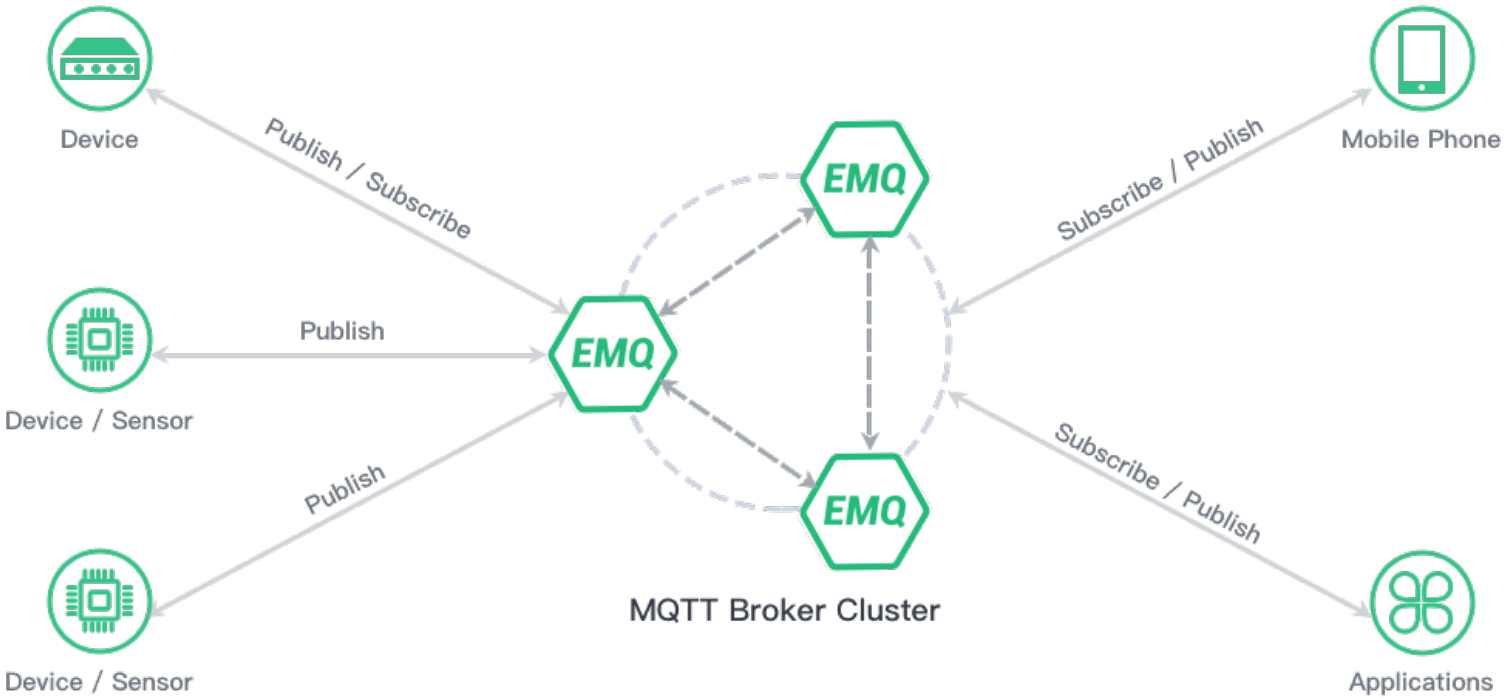
# Agenda for Discussion

1. Messaging Protocols for IoT
2. MQTT Overview
3. Architecture
   - Architecture Key Terms
4. Quality of Service (QoS)
5. Wildcards
6. Advanced Features
   - Retained Message
   - Birth/Death Message
   - LWT Message

# MQTT Overview

- Message Queuing Telemetry Transport
- Developed by Andy Stanford-Clark (IBM) and Arlen Nipper (Cirrus Link) in 1999
- Designed for Machine-to-Machine communication - small code size and limited network bandwidth
- Publish-Subscribe model
- Works on top of TCP/IP

# EMQ MQTT Architecture



# Architecture Key Terms

- **Broker**: Accepts messages from clients and then delivers them to any interested clients. (Sometimes brokers are called "servers.")
- Client: Thing which can connect to broker to send and receive required information. Unique ID called Client ID.
- Topic: Namespace (or place) for messages on the broker. Clients subscribe and publish to a topic.
- Publish: Client sending a message to the broker, using a topic name.
- Subscribe: Client tells the broker which topics it is interested. The broker sends messages published to that topic.

# Quality of Service (QoS)

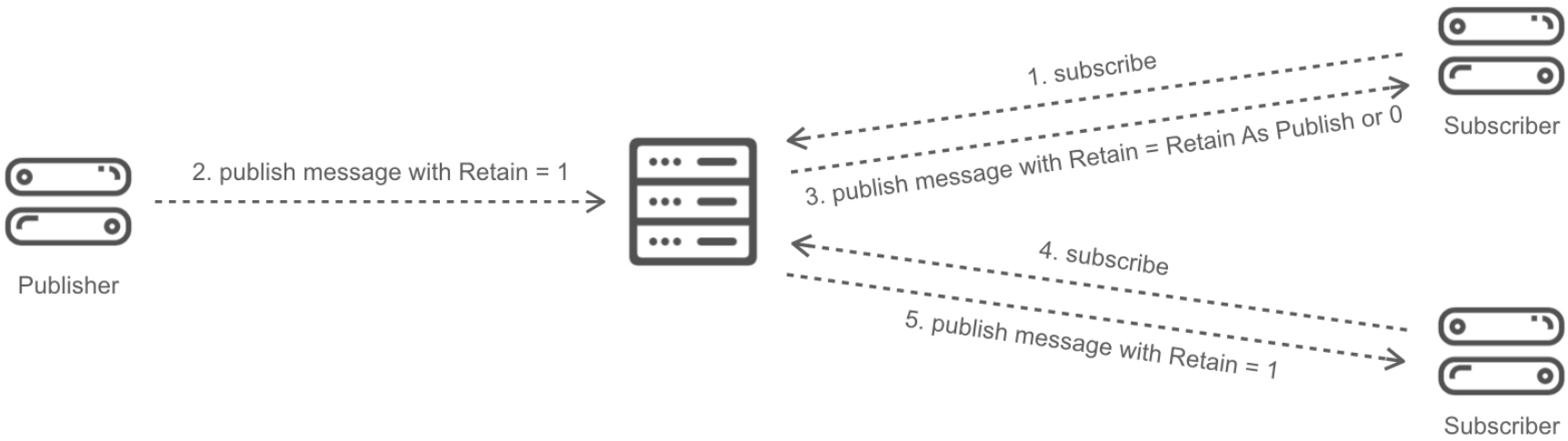
- **QoS 0 (At most once)** - where messages are delivered according to the best efforts of the operating environment. Message loss can occur.
- **QoS 1 (At least once)** - where messages are assured to arrive but duplicates can occur.
- **QoS 2 (Exactly once)** - where message are assured to arrive exactly once. Safest but slowest mode.

**The higher the QoS, the lower the performance speed**

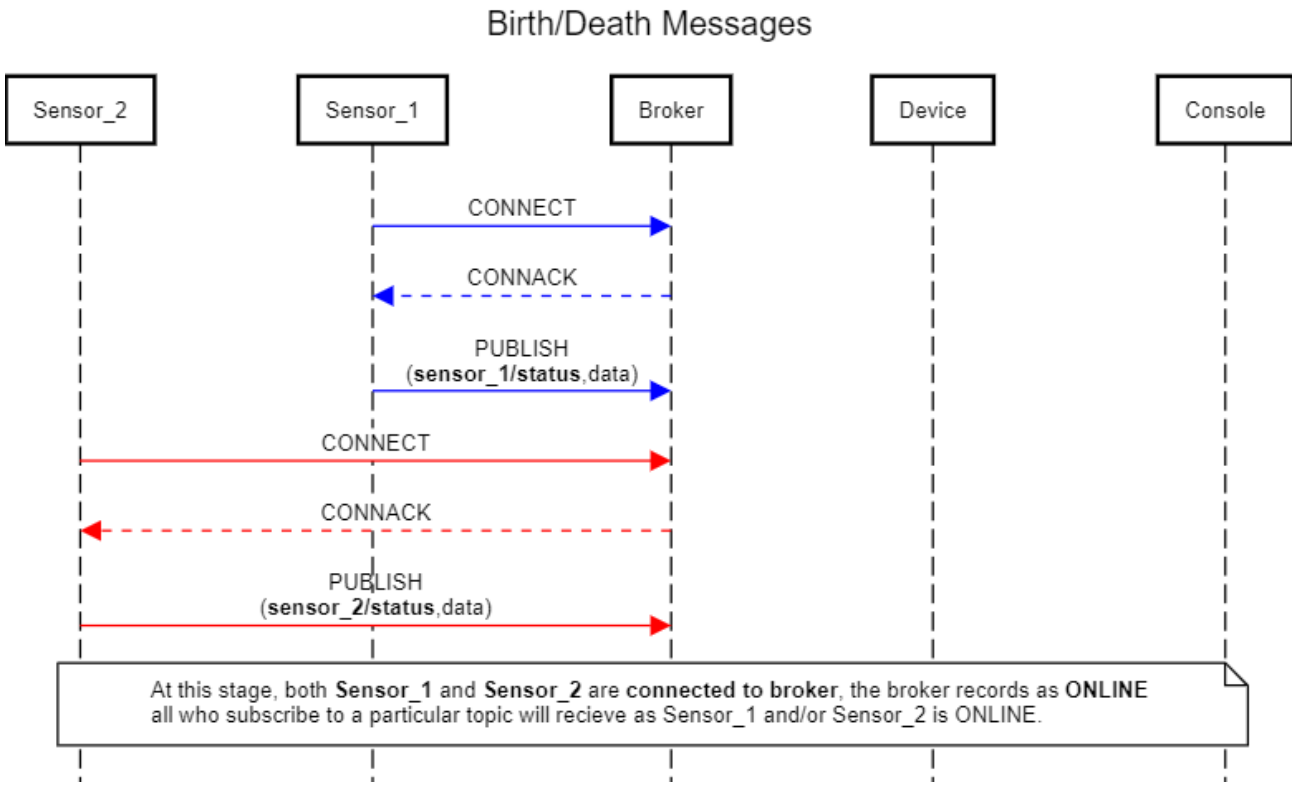
# Wildcards

- Helps the developer to subscribe to multiple topics simultaneously
- Wildcard is only available for Subscription, not for Publishing
- Two wildcard character are supported:
  - **'#':** represents a complete sub-tree of the hierarchy.
    Example Sensor/dht11/#.
    This will match any topic starting with Sensor/dht11, such as Sensor/dht11/Temperature, Sensor/dht11/Humidity.
  - **'+':** represents a single level of the hierarchy.
    Example, Sensor/+/TEMP will match Sensor/dht11/Temperature and Sensor/dht22/Temperature.

# Retained Message



# Birth/Death Message



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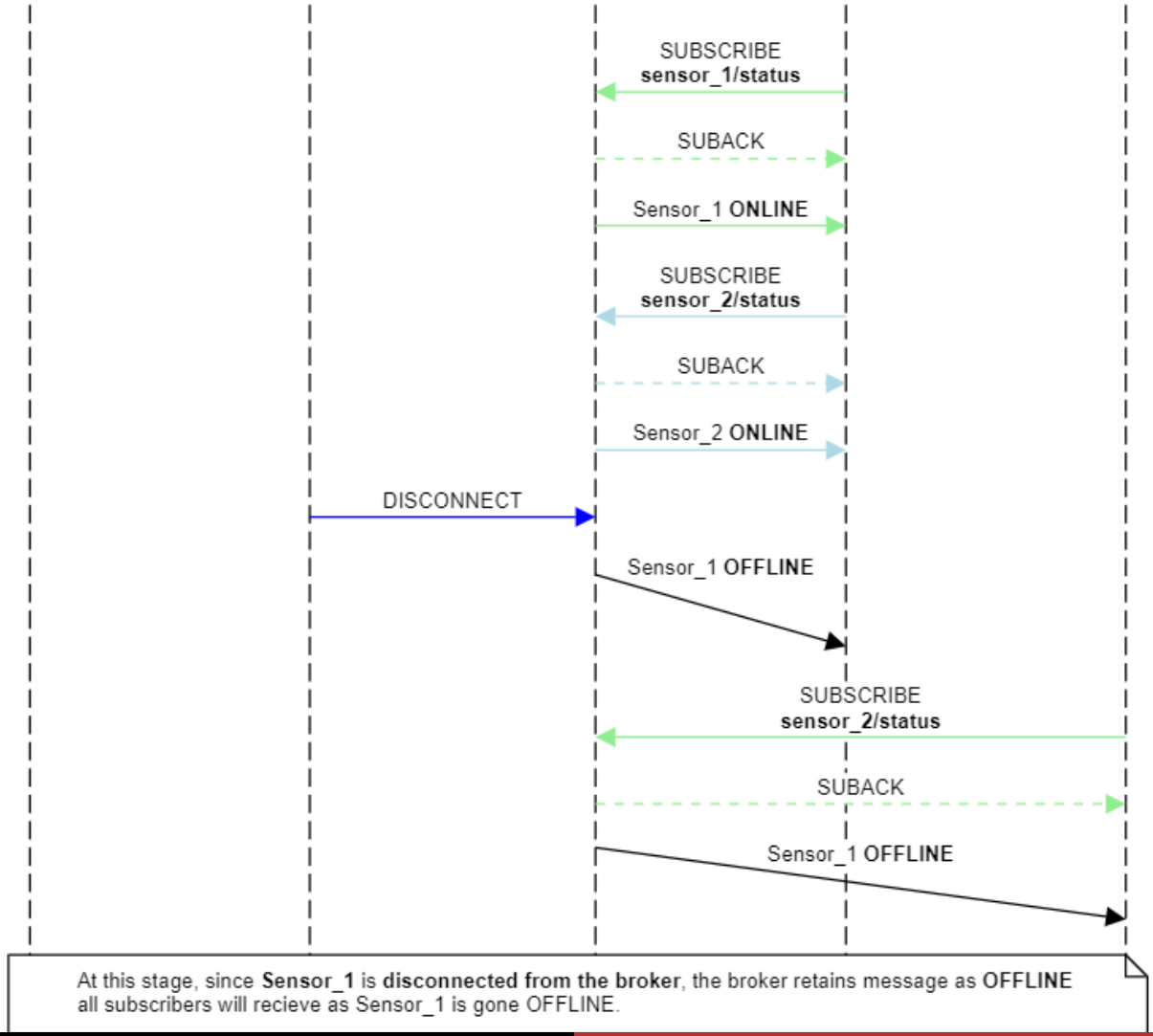
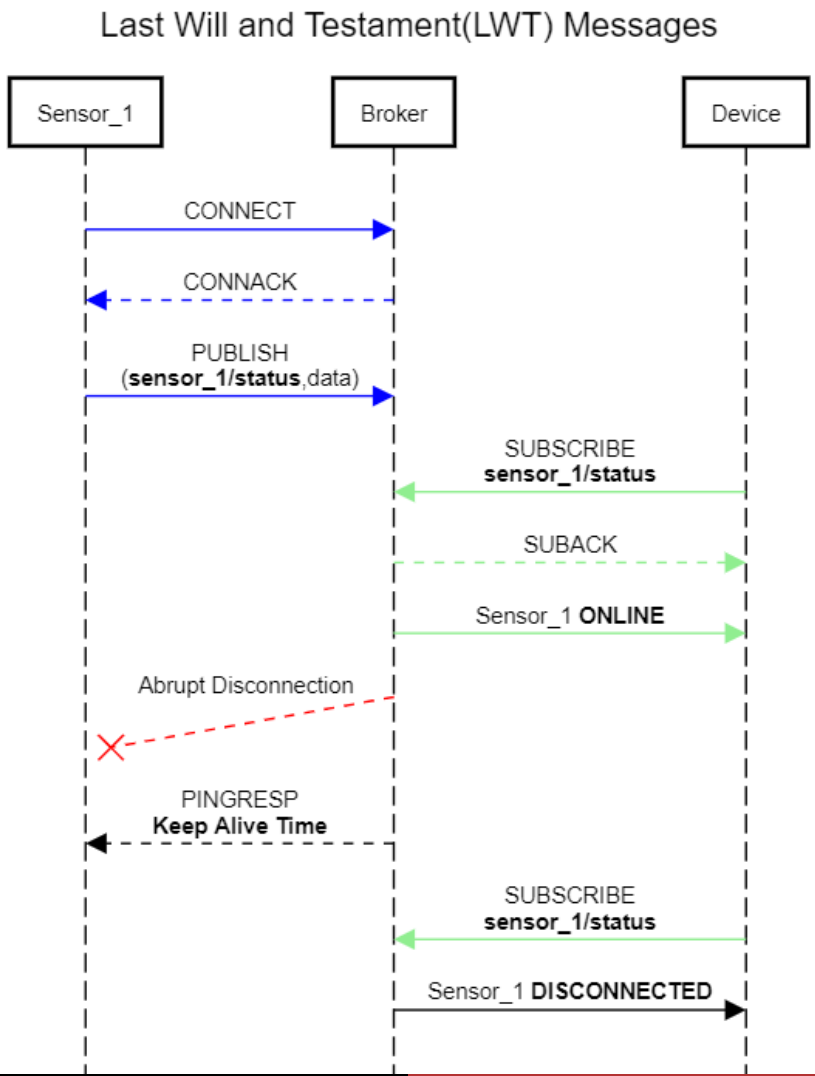

SUBSCRIBE
sensor_1/status
SUBACK
Sensor_1 ONLINE
SUBSCRIBE
sensor_2/status
SUBACK
Sensor_2 ONLINE
DISCONNECT
Sensor_1 OFFLINE
SUBSCRIBE
sensor_2/status
SUBACK
Sensor_1 OFFLINE
At this stage, since Sensor_1 is disconnected from the broker, the broker retains message as OFFLINE
all subscribers will recieve as Sensor_1 is gone OFFLINE.

# LWT Message


Last Will and Testament(LWT) Messages
Sensor_1
Broker
Device
CONNECT
CONNACK
PUBLISH
(sensor_1/status,data)
SUBSCRIBE
sensor_1/status
SUBACK
Sensor_1 ONLINE
Abrupt Disconnection
PINGRESP
Keep Alive Time
SUBSCRIBE
sensor_1/status
Sensor_1 DISCONNECTED