FRANKFURT UNIVERSITY OF APPLIED SCIENCES

MQTT and IoT

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Agenda

Motivation

MQTT

MQTT Features

MQTT in Action

Case Study

References

Motivation

- IoT and Communication Protocol
- Communication Challenges
  - Remote Location
  - Low Bandwidth
  - Limited Internet
  - Power Usage
  - Speed
  - Compatibility
- Solution: MQTT - An open OASIS and ISO/IEC 20922 [1] Standard Communication Protocol

Introduction

- What is MQTT?
- First Version and Purpose
- Focus shift from Embedded Systems to IoT

MQTT Publish-Subscribe Architecture

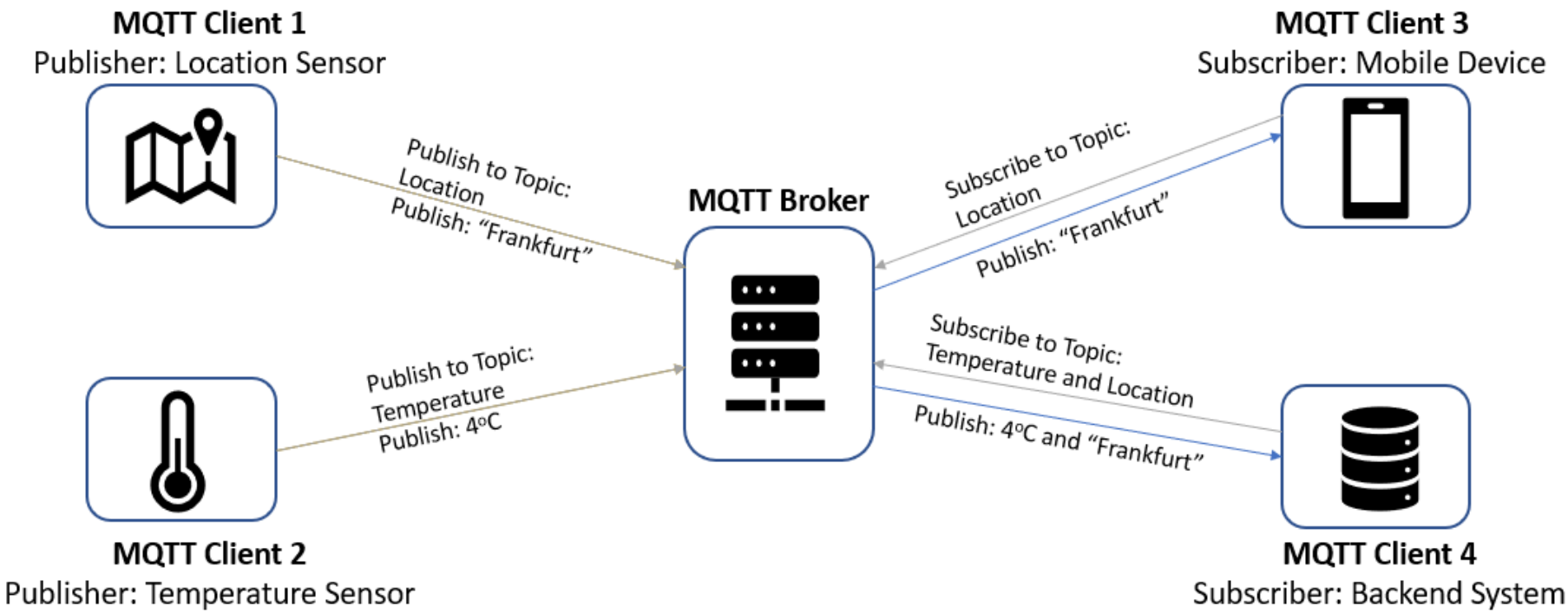


Figure: MQTT Network Structure

MQTT Client

- 2 Types
  - Publisher
  - Subscriber
- An MQTT Client can be both Publisher and Subscriber at a time
- Client Connection

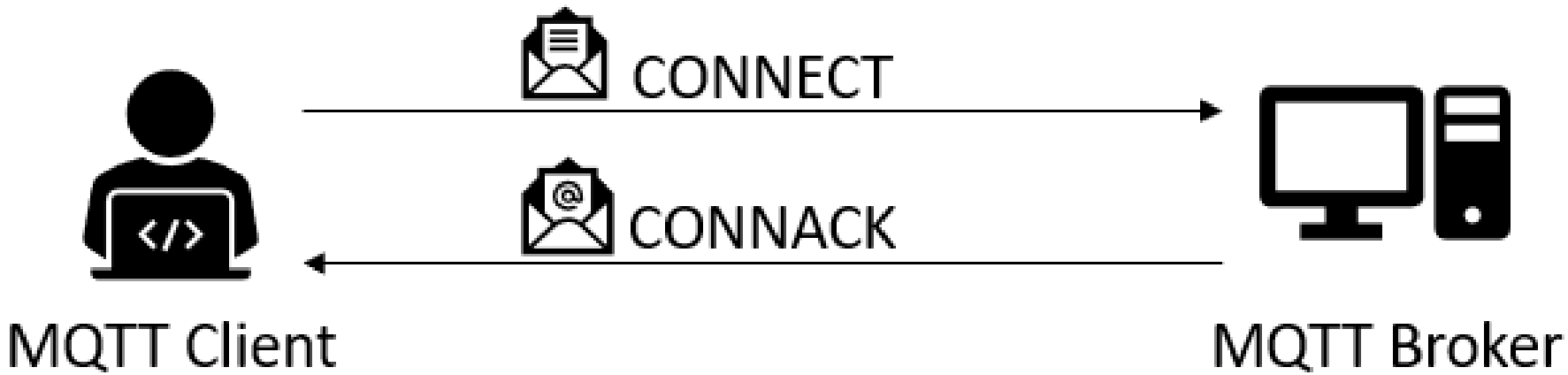


Figure: Client Connection Establishment in MQTT

Topic

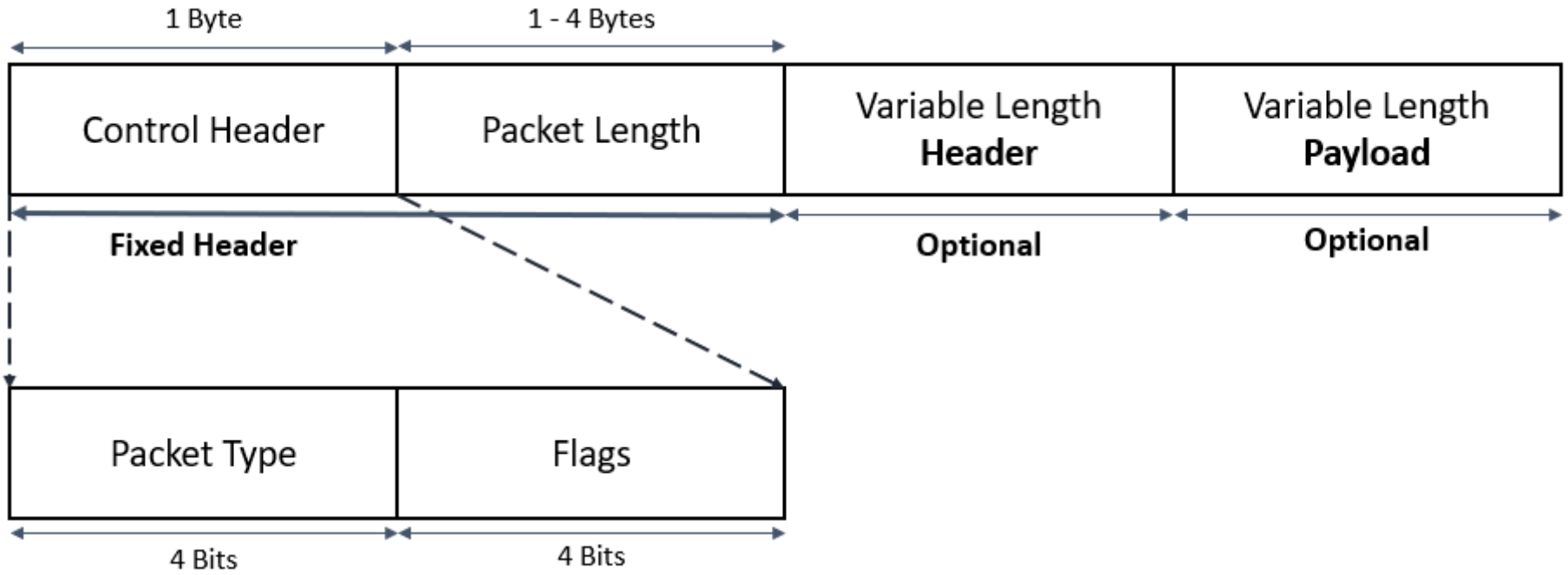
- Key to filter out messages
- Uniquely identify different Message Groups
- Represented in the form of UTF-8 Strings
- Separated by Slash "/"
- Case Sensitive
- Example
  - room1/temperature and room2/temperature
  - room1/temperature and room1/humidity

MQTT Broker

- Central Unit
- Receive, Filter and Broadcast Messages
- Broker is a Software running on a device
- On Premise / In the Cloud
- Self Built / Third Party Hosted
- Open Source / Proprietary
- Responsible for
  - Eliminating Vulnerable and Insecure Client Connections
  - Managing and Tracking Client Connection States
  - Reducing Network Strain
  - Automatic Handover to Backup Broker
- Services
  - Retained Messages [2]
  - Persistent Sessions

MQTT Packet Structure

- Communication in MQTT takes place in the form of Packets.
- MQTT Packet structure varies according to the Message type.
- 3 Possible Packet Formats
  - with Fixed Header
  - with Fixed Header + Variable Header
  - with Fixed Header + Variable Header + Variable Payload



Home Automation Scenario

Turn Home-Office Lamp ON

- Publisher Client: Node RED
- Subscriber Client: ESP 8266
- Broker: Eclipse Mosquitto
- Topic: home/office/lamp

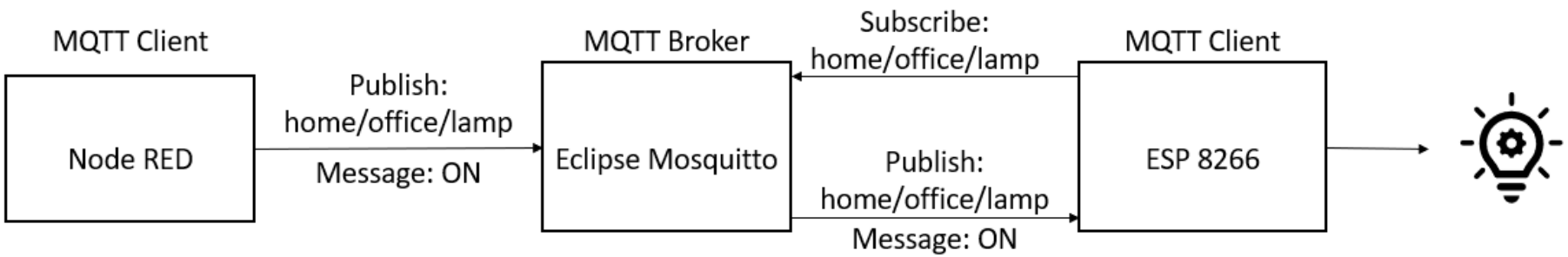


Figure: IoT Scenario using MQTT

MQTT Features

- MQTT Clients
  - Small in Size
  - Require minimum resources to run
  - Run on small microcontrollers
  - Utilize low network bandwidth
  - Unaware of other clients' IP address and Domain
- MQTT can scale to connect millions of IoT devices
- TLS Encryption
- Username and Password protected Connection
- MQTT is loosely coupled and more secure!
- Improved Average Response Time and Data Transfer per message
- Support for Unreliable Networks
- Reliable Message Delivery

Communication Reliability

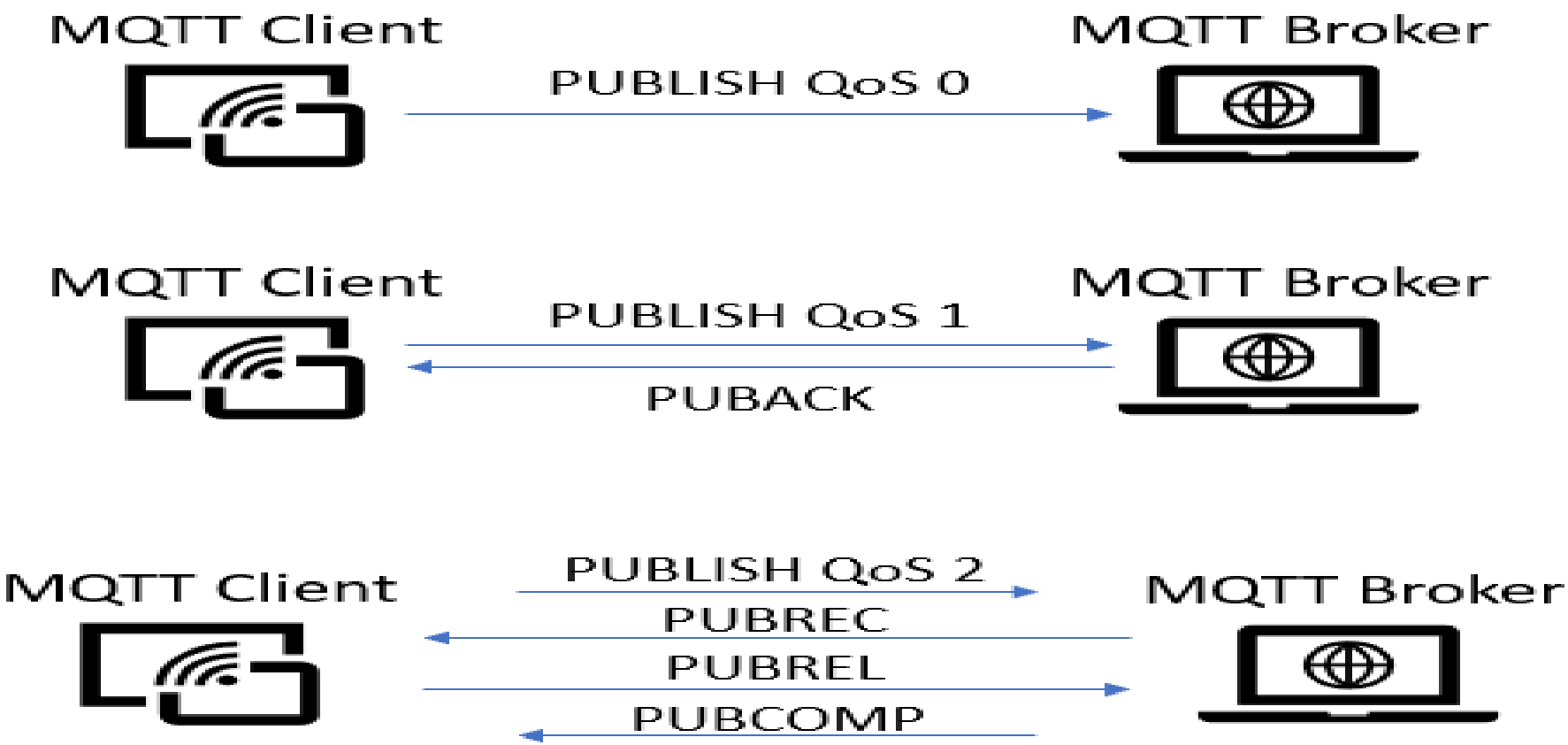


Figure: QoS0, QoS1 and QoS2 in MQTT

Communication Mode

One-To-Many

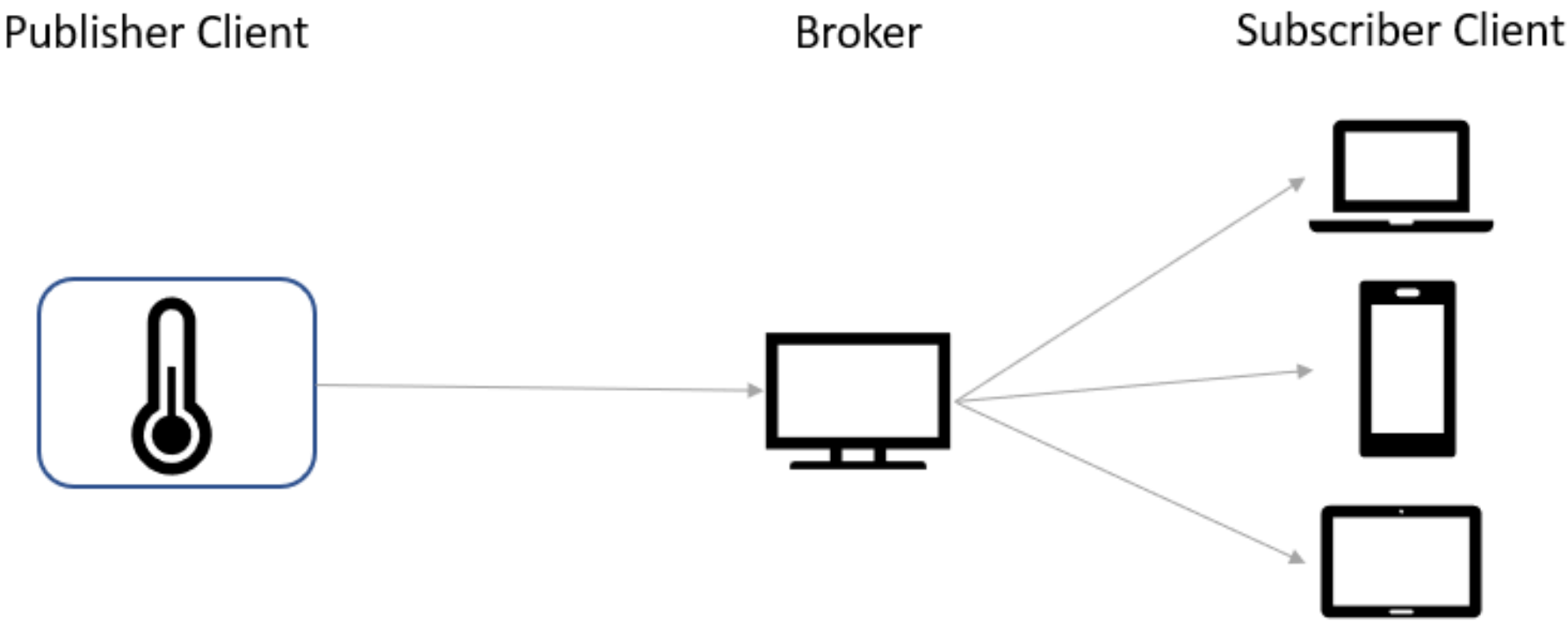


Figure: One-To-Many Structure in MQTT

Communication Mode

Many-To-One

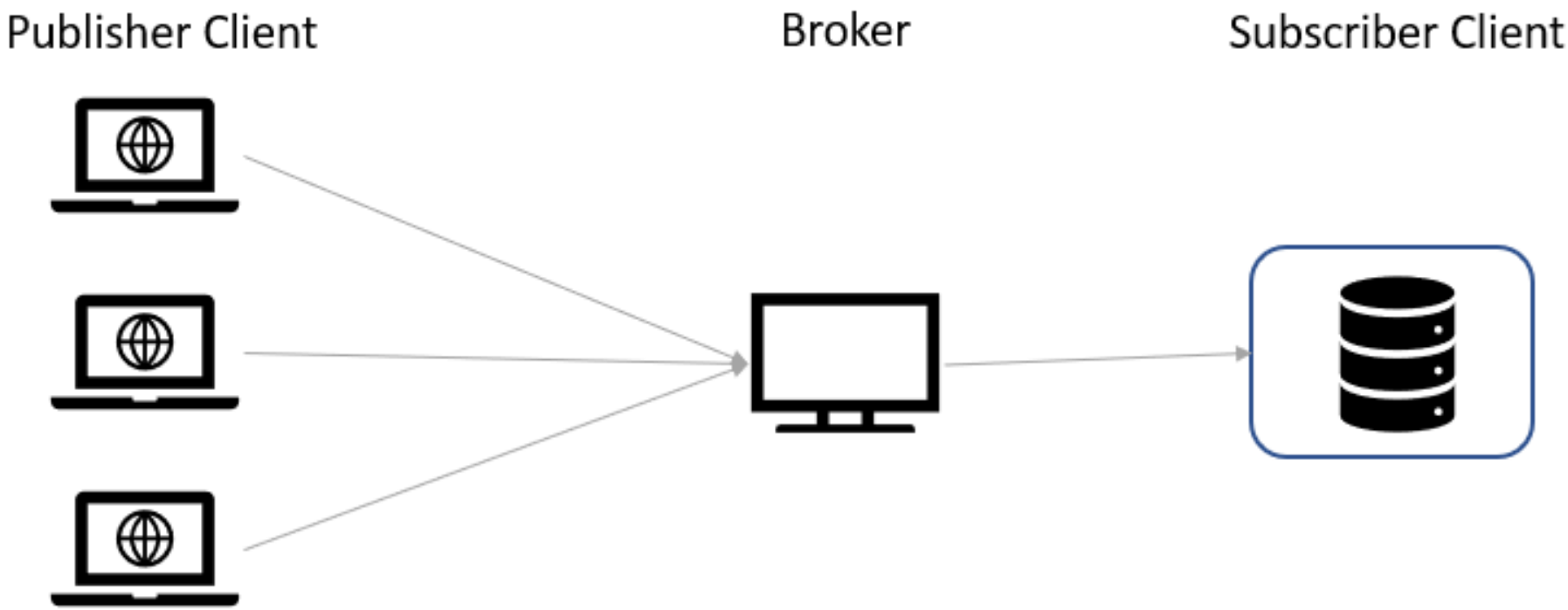


Figure: Many-To-One Structure in MQTT

MQTT in Action

MQTT is used in a wide variety of industries:

- Automotive - HiveMQ in BMW Car Sharing Application [3]
- Logistics - Matternet's Autonomous Drones [3]
- Manufacturing - Celikler Holding's Power Plant Monitoring [4]
- Smart Home - IBM Telemetry for Home Energy Monitoring and Control
- Consumer Products - Smart Kitchen Appliances
- Transportation - DB Railway System

A Case Study

Deploying IoT on Germany's DB Railway System [5]

- Deutsche Bahn - One of the biggest Transportation Companies in the World
- DB uses combination of HTTP and MQTT as the Communication Standard
- MQTT Client - Eclipse Paho
- MQTT Broker - IBM MessageSight
- Use Cases
  - Long Distance Trains
  - Dynamic Text Displays
  - Escalators & Elevators
  - Eclipse Mosquitto on DB ICE Train

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