MQTT

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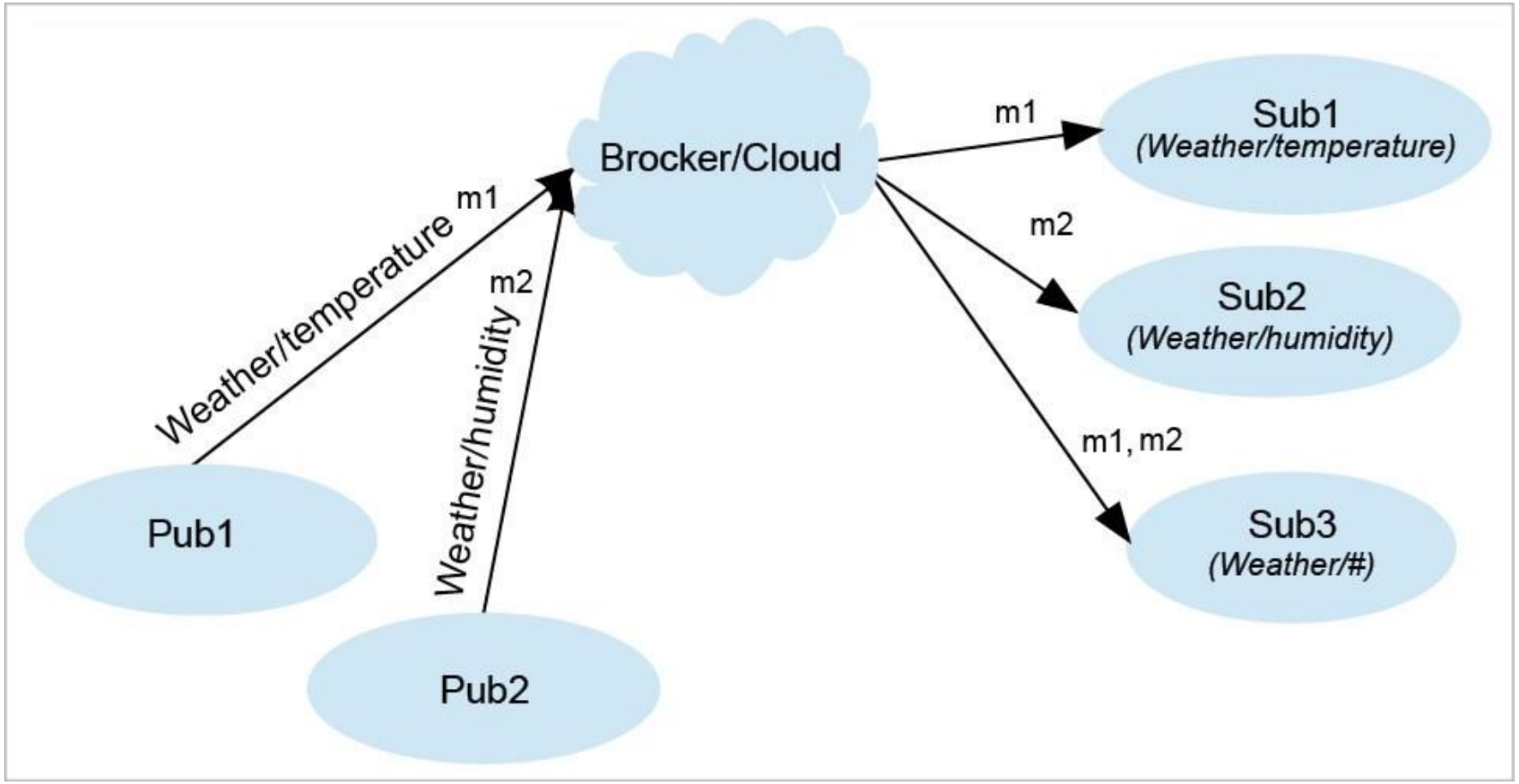
MQ Telemetry Transport

- *MQTT is a machine-to-machine, Internet of Things connectivity protocol.*
- *It is an extremely lightweight* ***publish-subscribe communication model****, useful for connections in remote locations where a small code footprint is the order of the day.*
- It was initially developed by IBM and is of OASIS standard now, with the latest release of v3.1.1 in 2013.

MQTT Architecture

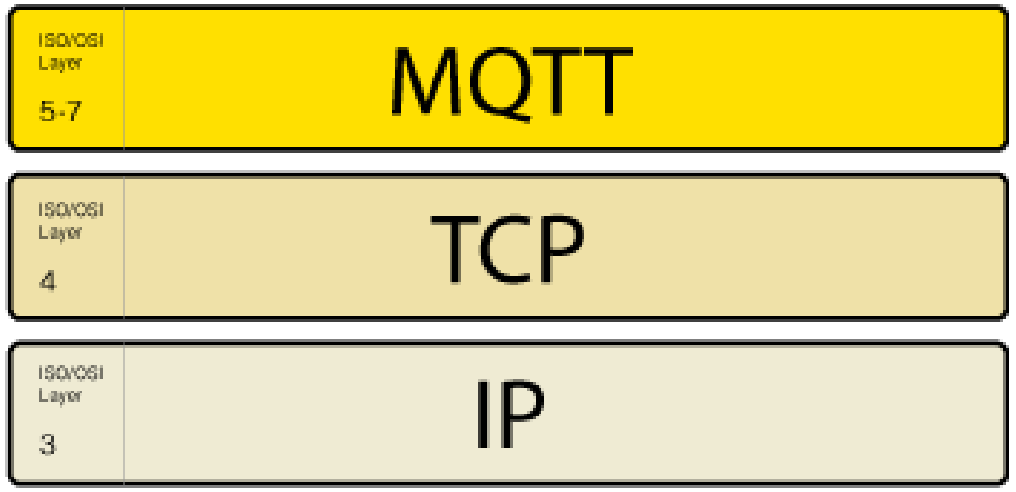


MQTT Architecture

- MQTT nodes communicate in a one-to-many mapping model, where a message sent by one client (the publisher) is delivered to many clients (subscribers) through topic names.
- Messages are exchanged via a central node known as the broker.

MQTT Packet Structure

- The MQTT protocol is based on top of TCP/IP and both client and broker need to have a TCP/IP stack.



MQTT Packet Structure

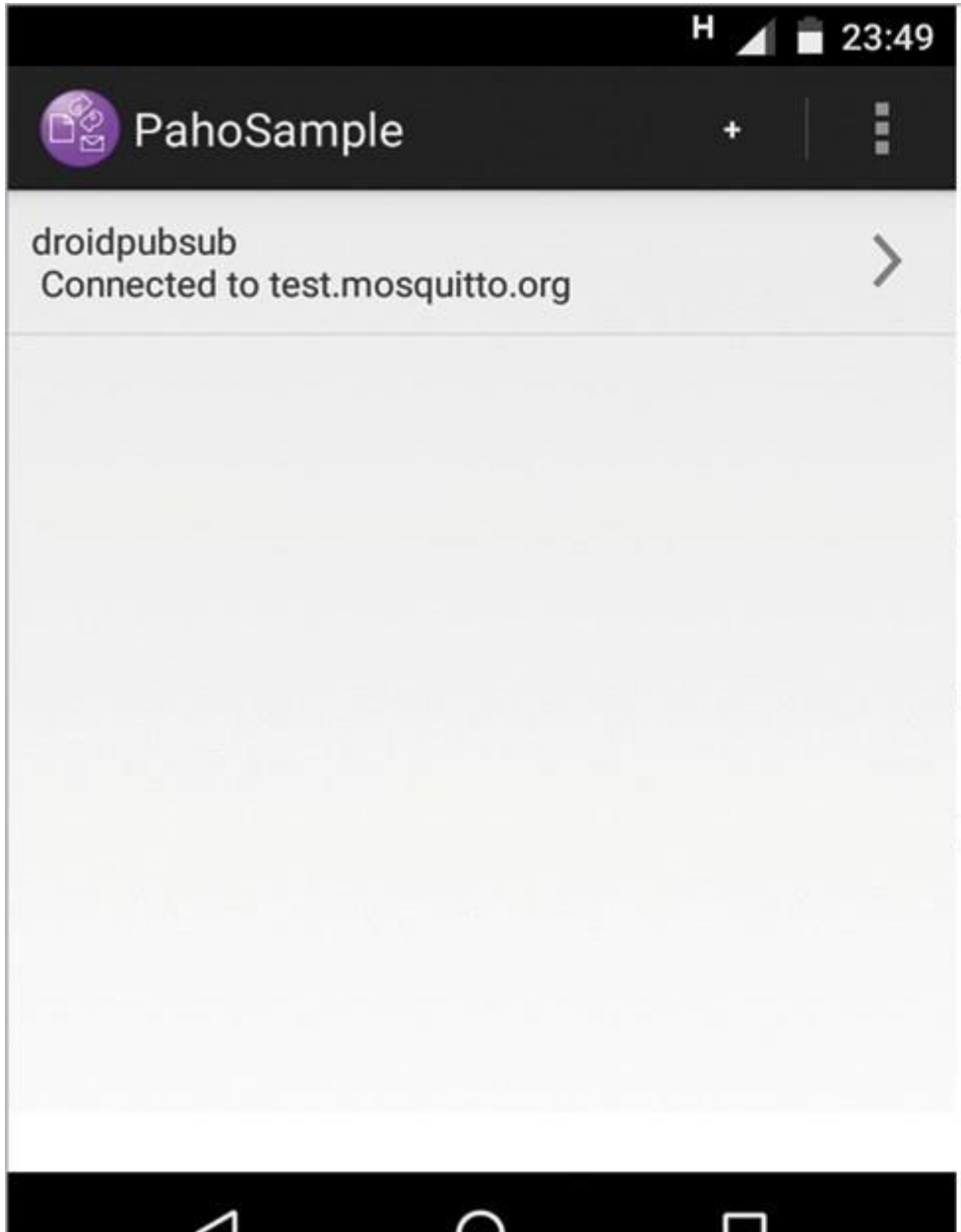
Packet Type (4 bits)	Header Flags (4 bits)
Remaining Length (No. of byte:min-1, max-4)	
Optional header elements (protocol, flags, keep alive etc.)	
Payload (client id, will message, username, password etc.	

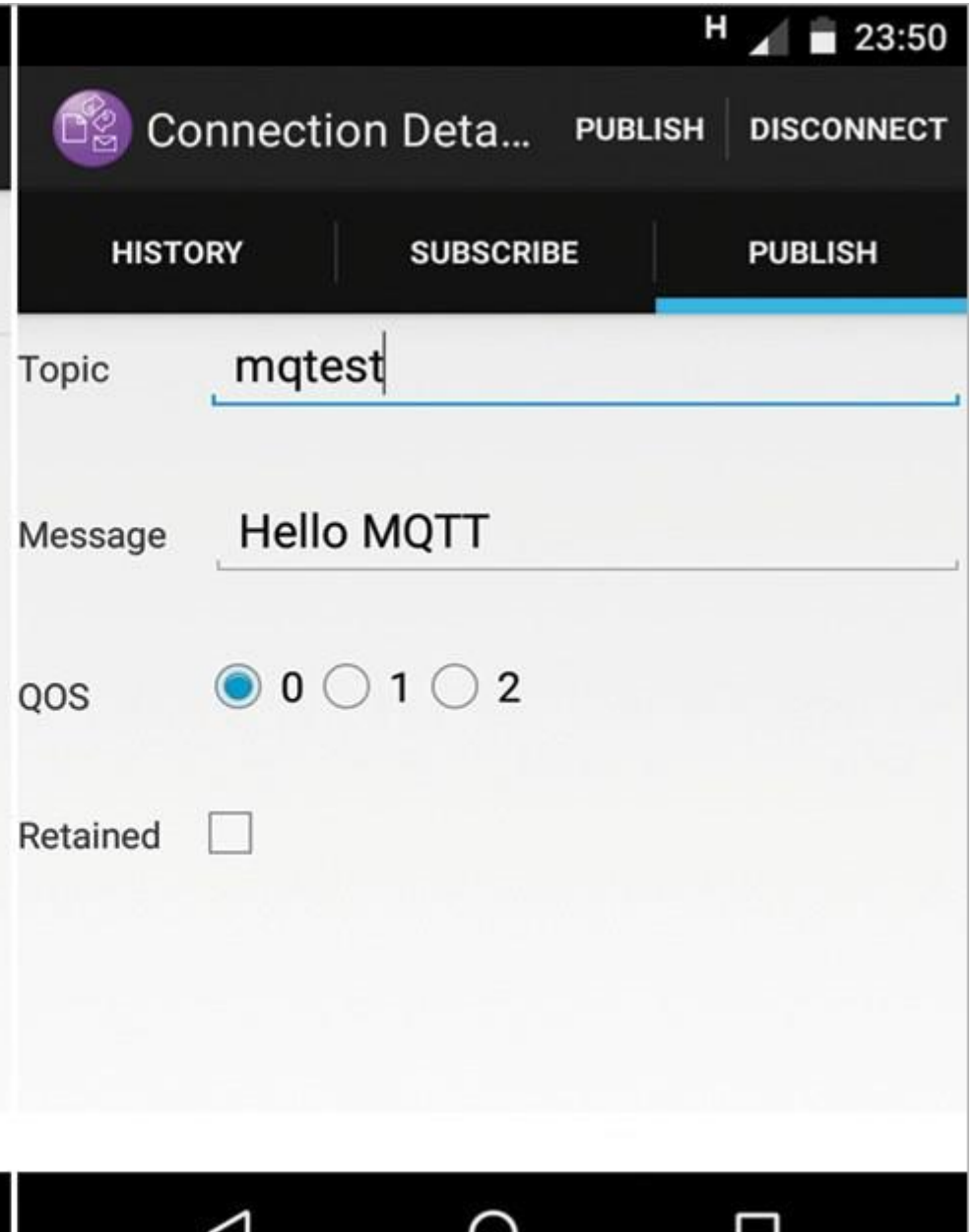
MQTT Packet Structure

Packet Type	Code	Packet Type	Code
Reserved	0	SUBSCRIBE	8
CONNECT	1	SUBACK	9
CONNACK	2	UNSUBSCRIBE	10
PUBLISH	3	UNSUBACK	11
PUBLICK	4	PINGREQ	12
PUBREC	5	PINRESP	13
PUBREL	6	DISCONNECT	14
PUBCOMP	7	Reserved	15

MQTT Packet Structure

- **QoS levels**
  MQTT supports three levels of QoS, specified by each published message and while subscribers are connecting.
- *QoS 0 (Maximum once):* This is also known as ‘fire and forget’; no acknowledgement is sent by the receiver.
- *QoS 1 (At least once):* Each published message will be acknowledged using PUBACK; the sender retransmits a message if no acknowledgement is received within a time-out by setting the DUP flag.
  QoS 2 (Exactly once): Sender and receiver exchange *PUBLISH, PUBREC, PUBREL, PUBCOMP* to ensure assured delivery of messages without duplicates.


H
23:49
PahoSample
+
droidpubsub
Connected to test.mosquitto.org


H
23:50
Connection Deta...
PUBLISH
DISCONNECT
HISTORY
SUBSCRIBE
PUBLISH
Topic
mqtest
Message
Hello MQTT
QOS
0
1
2
Retained

MQTT brokers

- MQTT clients exchange messages via the **broker node**.
- The broker is not identical to a typical server, as apart from message reception an
- Mosquitto is an Eclipse IOT project, lightweight broker implementation written in C and it supports MQTT protocol versions 3.1 and 3.1.1.
- For building Mosquitto, install the dependency *libcares-devel.*d delivery, it has little functionality.

MQTT Clients

- Eclipse Paho client library with support for many languages and the other is from the Mosquitto library.
- Paho provides APIs for two types of clients for operations like connect, publish, subscribe, unsubscribe, etc.
- 1. ***Synchronous API****:* The above operations are blocked until they are completed and run in a single thread.
  2. ***Asynchronous API****:* Call backs are specified using threads, to notify clients when the above operations are completed using the concerned acknowledgements.

MQTT Man pages

- **About mosquito:**

$ man 8 mosquito ; man 7 mqtt

$ man 5 mosquito.conf

- **Mosquitto commands:**

$ man 1 mosquitto_pub ;

$ man 1 mosquitto_sub;

$ man 1 mosquitto_passwd

Mosquitto libraries:

$ man 3 libmosquitto

Monitoring MQTT packets using Wireshark tool.

- For each packet, observe the message type (packet type) in the fixed header and Msg Len (remaining length).

```
mosquitto_sub -t hello
mosquitto_pub -t hello -l #payload from stdin,line wise
```

Monitoring MQTT packets using Wireshark tool.

- In the CONNECT packet, find out the protocol name, version, connect flags, keep alive value and client ID as part of the variable header. Observe the protocol name and version for both v3.1 and v3.1.1 by specifying *V mqttv31* or -V *mqttv311* for Mosquitto clients.

Monitoring MQTT packets using Wireshark tool.

- For each publisher, you can find the flow of CONNECT, CONNACK, PUBLISH and DISCONNECT when the client terminates. You can also identify QoS level in header flags and there will be no acknowledgment for QoS 0.

```
$ mosquitto_pub -t hello -m abcd
$ mosquitto_pub -t hello -l #hit ctrl+D to quit
```

Monitoring MQTT packets using Wireshark tool.

- For QoS 1, observe the flow of PUBLISH, PUBACK. Also match the message identifier in PUBLISH, PUBACK packets.

```
$ mosquitto_pub -t hello -m abcd -q 1
```

- For QoS 2, observe the flow of PUBLISH, PUBREC, PUBREL, PUBCOMP with the same message identifier.

```
$ mosquitto_pub -t hello -m abcd -q 2
```