

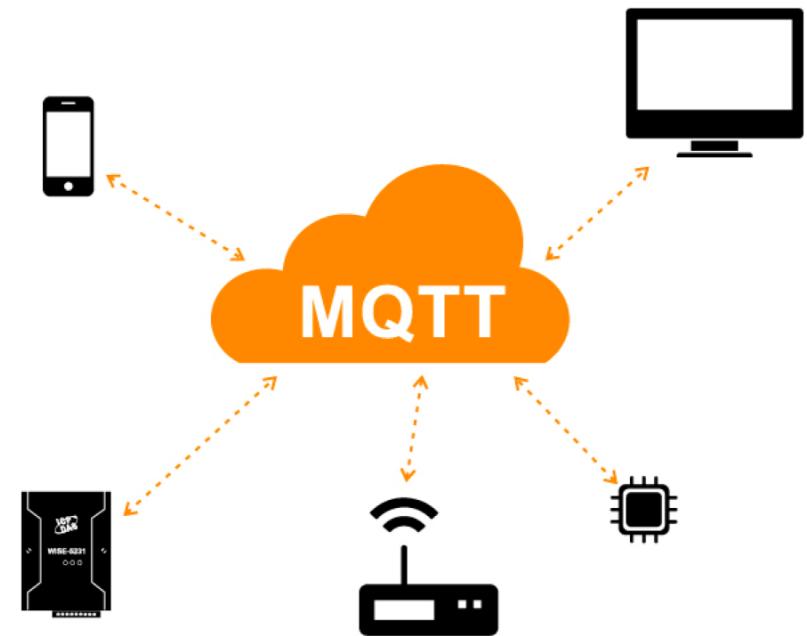
# *Intro to MQTT*

**Pietro Manzoni**

*Universitat Politecnica de Valencia (UPV)*

*Valencia - SPAIN*

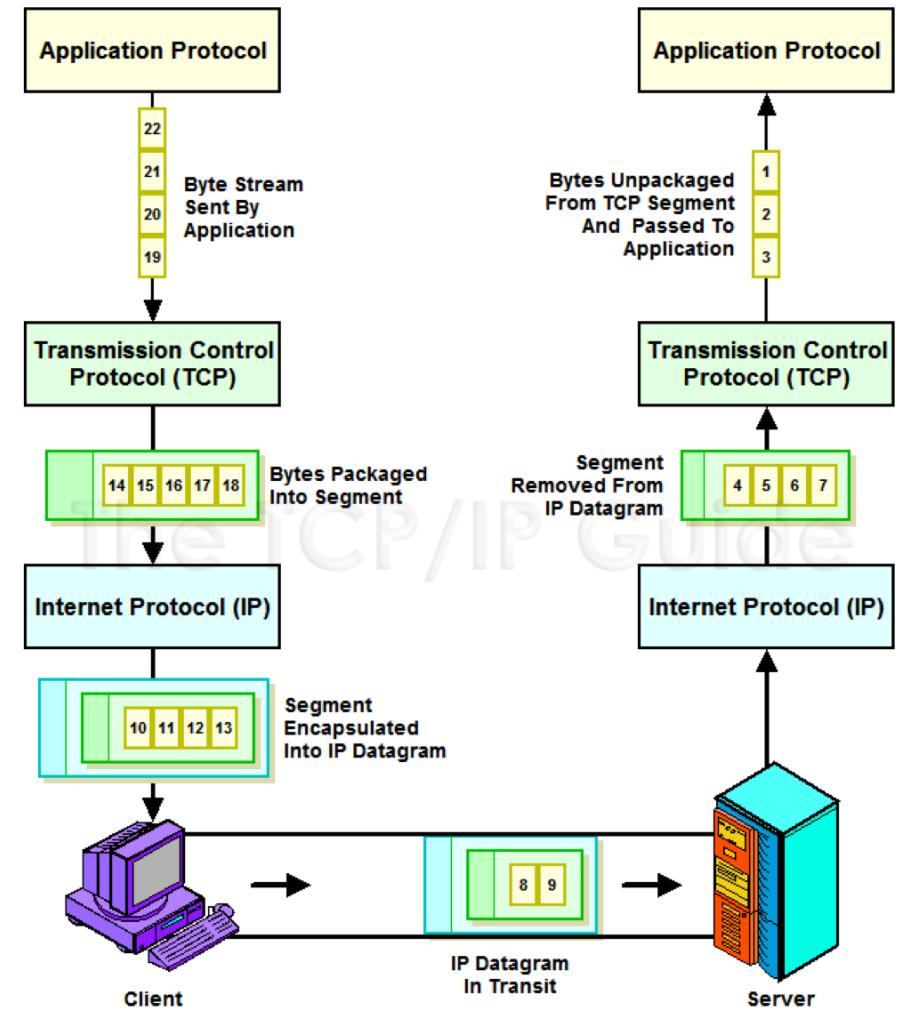
*pmanzoni@disca.upv.es*



[https://github.com/pmanzoni/pythonMQTT\\_062018](https://github.com/pmanzoni/pythonMQTT_062018)

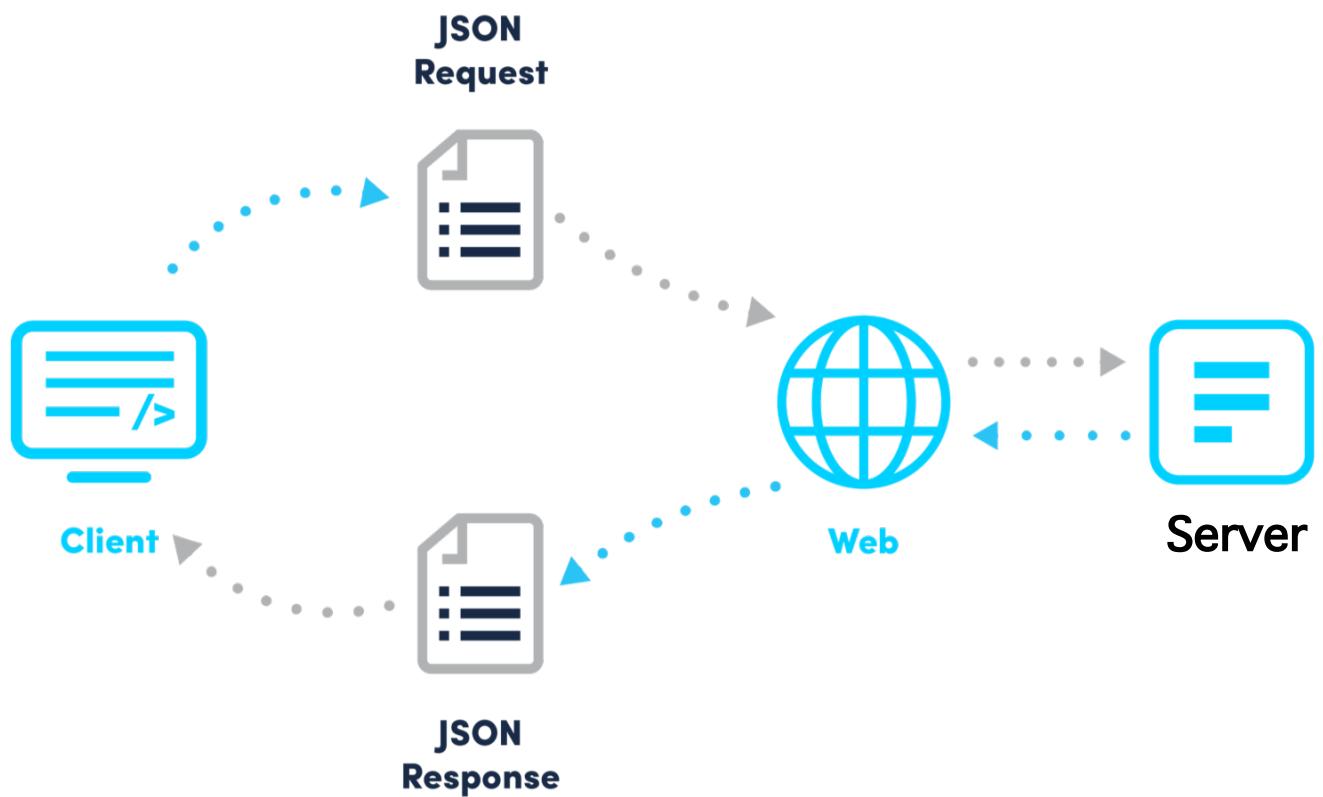
# From “byte streams” to “messages”

- The “old” vision of data communication was based on **reliable byte streams**, i.e., TCP
- Nowadays **messages interchange** is becoming more common
  - E.g., Twitter, Whatsapp, Instagram, Snapchat, Facebook,...
- Actually is not that new...
  - emails: SMTP+MIME,
  - FTP,
  - uucp



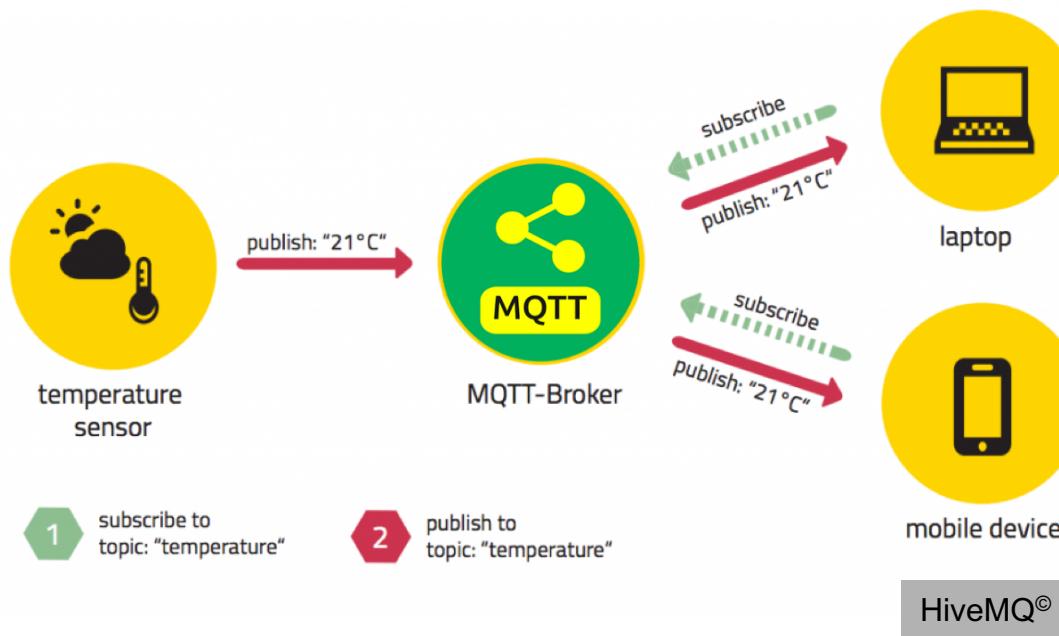
# Interchanging messages: request/response paradigm

- REST: Representational State Transfer
- Widely used; based on HTTP
- Lighter version: CoAP



# Interchanging message: pub/sub paradigm

- Publish/Subscriber
  - aka: producer/consumer
- Growing paradigm
  - E.g., <https://cloud.google.com/iot/docs/how-tos/mqtt-bridge>
- Various solutions
  - MQTT, AMQP, XMPP (was Jabber)



# Data Representation

{"value": 237} vs. <value>237</value>

- Data-interchange format: (1) should be easy for humans to read and write, and (2) should be easy for machines to parse and generate
- Two main formats:

## JavaScript Object Notation (JSON) [<http://www.json.org/>]

```
{ "menu": {  
    "id": "file",  
    "value": "File",  
    "popup": {  
        "menuitem": [  
            {"value": "New", "onclick": "NewDoc()"},  
            {"value": "Open", "onclick": "OpenDoc()"},  
            {"value": "Close", "onclick": "CloseDoc()"}  
        ]  
    }  
}
```

## XML

```
<menu>  
  <id>file</id>  
  <value>File</value>  
  <popup>  
    <menuitem>  
      <value>New</value>  
      <onclick>NewDoc()</onclick>  
    </menuitem>  
    <menuitem>  
      <value>Open</value>  
      <onclick>OpenDoc()</onclick>  
    </menuitem>  
    <menuitem>  
      <value>Close</value>  
      <onclick>CloseDoc()</onclick>  
    </menuitem>  
  </popup>  
</menu>
```

# JSON and Python

```
>>> import json

>>> d = {'sensorId': 'temp1', 'Value': 25}

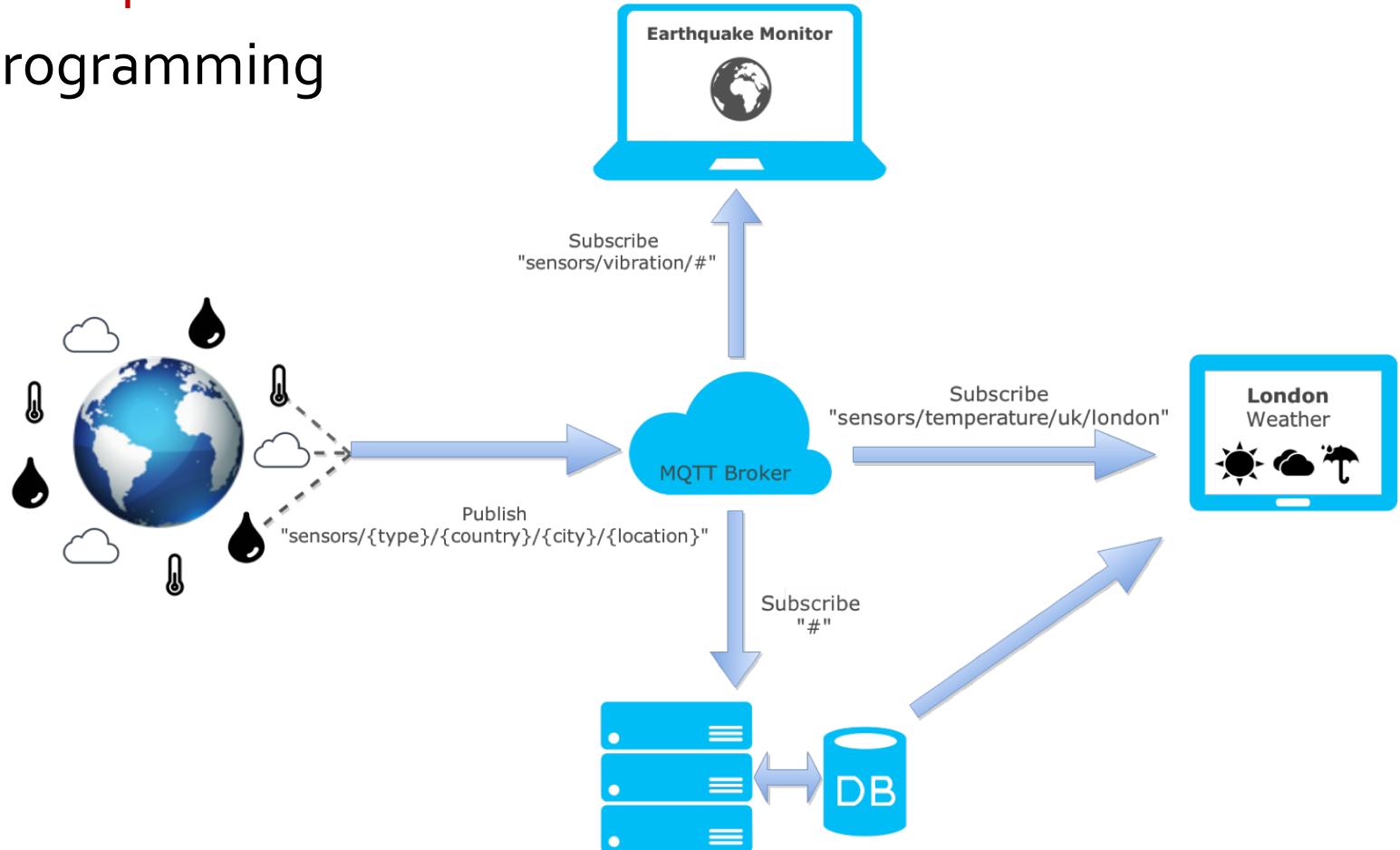
>>> d
{'sensorId': 'temp1', 'Value': 25}
>>> d['sensorId']
'temp1'

>>> dj = json.dumps(d)
>>> dj
'{"sensorId": "temp1", "Value": 25}'

>>> nd = json.loads(dj)
>>> nd
{u'sensorId': u'temp1', u'Value': 25}
>>> nd['sensorId']
u'temp1'
```

# MQTT

- Basic concepts
- Basic programming



Source: <https://zoetrope.io/tech-blog/brief-practical-introduction-mqtt-protocol-and-its-application-iot>

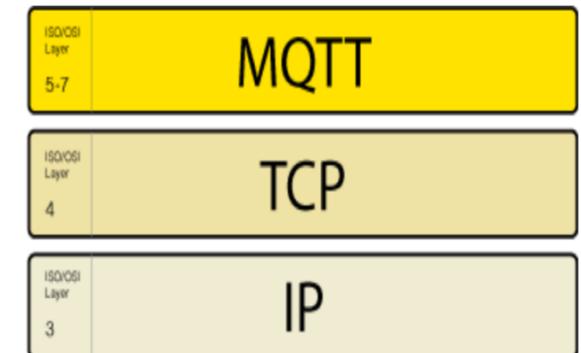
# Message Queuing Telemetry Transport

MQTT

- A **lightweight publish-subscribe protocol** that can run on embedded devices and mobile platforms → <http://mqtt.org/>
  - The MQTT community wiki: <https://github.com/mqtt/mqtt.github.io/wiki>
  - A very good tutorial: <http://www.hivemq.com/mqtt-essentials/>
- Designed to provide a low latency two-way communication channel and efficient distribution to one or many receivers.
  - Assured messaging over fragile networks
  - Maximum message size of 256MB
    - not really designed for sending large amounts of data
    - better at a high volume of low size messages.
  - Binary compress headers
  - Low power usage.

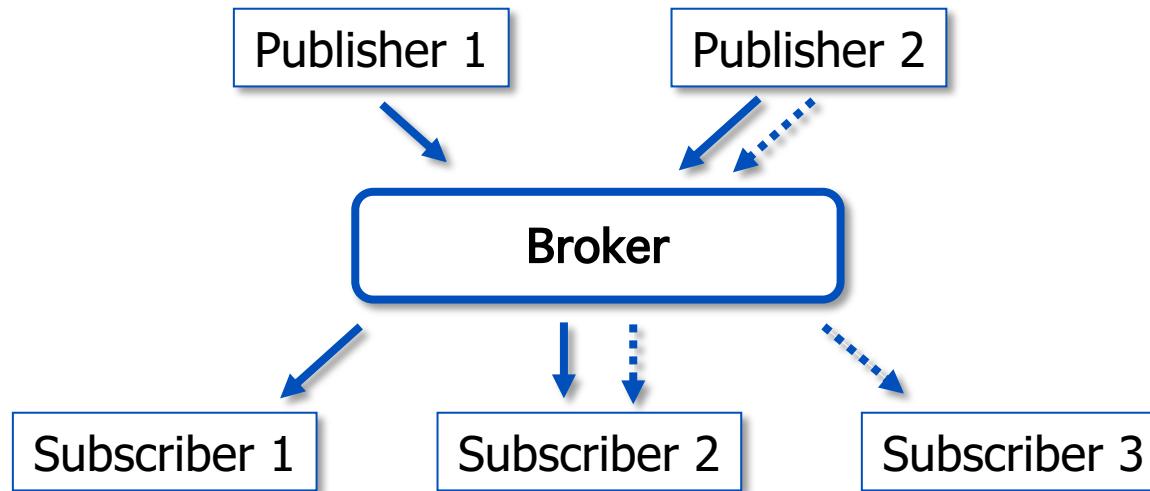
# MQTT overview

- MQTT is an open standard with a short and readable protocol specification.
  - October 29th 2014: MQTT was officially approved as OASIS Standard.
- **MQTT 3.1.1** is the current version of the protocol.
  - OASIS MQTT TC:  
[https://www.oasis-open.org/committees/tc\\_home.php?wg\\_abbrev=mqtt](https://www.oasis-open.org/committees/tc_home.php?wg_abbrev=mqtt)
  - Standard document here:  
<http://docs.oasis-open.org/mqtt/mqtt/v3.1.1/mqtt-v3.1.1.html>
- Works on top of the TCP protocol stack
  - There is also the closely related MQTT for Sensor Networks (MQTT-SN) where TCP is replaced by UDP;  
*TCP stack is too complex for WSN*



# Publish/subscribe pattern

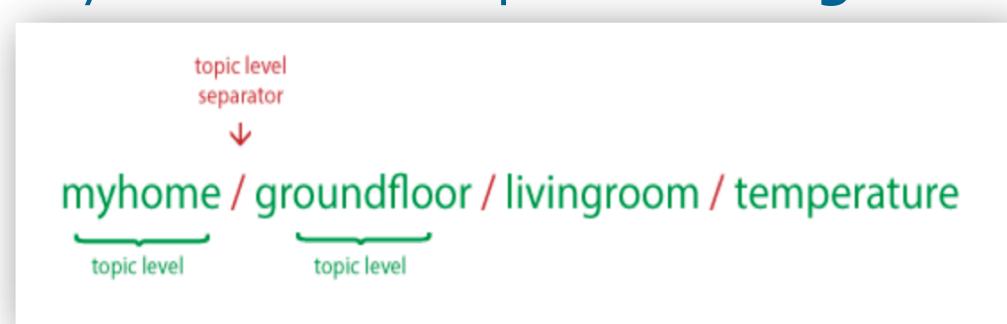
- Pub/Sub decouples a client, who is sending a message about a specific **topic**, called **publisher**, from another client (or more clients), who is receiving the message, called **subscriber**.
  - This means that the publisher and subscriber don't know about the existence of one another.
- There is a third component, called **broker**, which is known by both the publisher and subscriber, which filters all incoming messages and distributes them accordingly.



# Topics

- MQTT Topics are structured in a hierarchy similar to folders and files in a file system using the forward slash ( / ) as a delimiter.
- Allow to create a user friendly and self descriptive **naming structures**

- Topic names are:
  - Case sensitive
  - use UTF-8 strings.
  - Must consist of at least one character to be valid.
- Except for the \$SYS topic there is no default or standard topic structure.



Special \$SYS/ topics

- \$SYS/broker/clients/connected
- \$SYS/broker/clients/disconnected
- \$SYS/broker/clients/total
- \$SYS/broker/messages/sent
- \$SYS/broker/uptime

# Topics wildcards

- Topic subscriptions can have wildcards. These enable nodes to subscribe to groups of topics that don't exist yet, allowing greater flexibility in the network's messaging structure.

- '+' matches anything at a given tree level
  - '#' matches a whole sub-tree

- Examples:

- Subscribing to topic `house/#` covers:

`house/room1/main-light`

`house/room1/alarm`

`house/garage/main-light`

`house/main-door`

- Subscribing to topic `house/+/main-light` covers:

`house/room1/main-light`

`house/room2/main-light`

`house/garage/main-light`

- but doesn't cover

`house/room1/side-light`

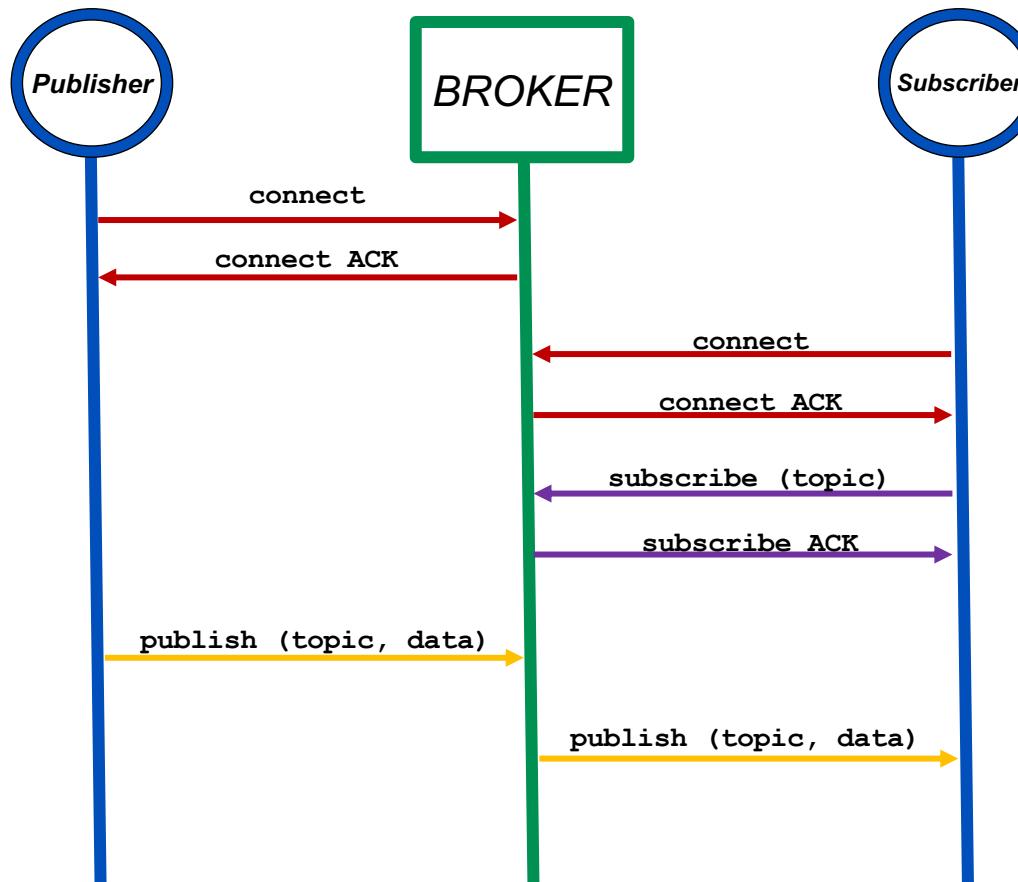
`house/room2/side-light`

# Topics best practices

- First of all:
  - Don't use a leading forward slash
  - Don't use spaces in a topic
  - Use only ASCII characters, avoid non printable characters
- Then, try to..
  - Keep the topic short and concise
  - Use specific topics, instead of general ones
  - Don't forget extensibility
- Finally, be careful and don't subscribe to #

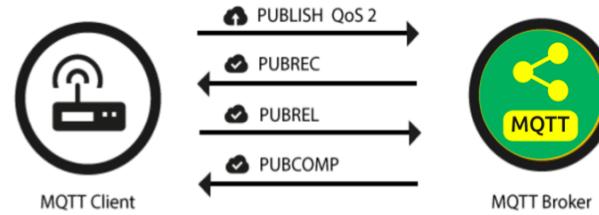
Why?

# Publish/subscribe interactions sequence



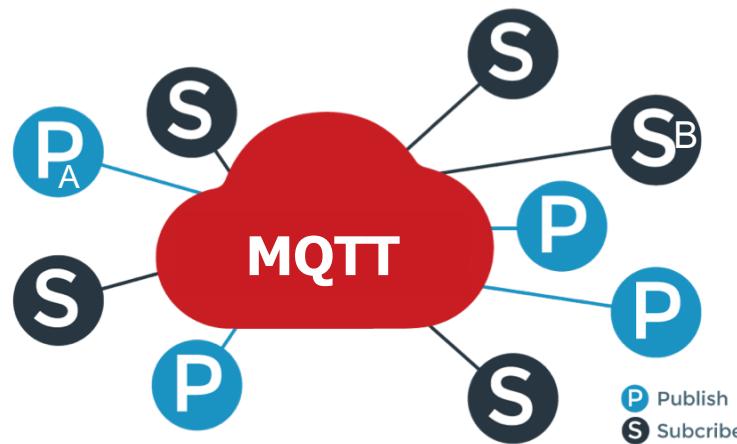
# Quality of Service (QoS)

- Messages are published with a **Quality of Service (QoS)** level, which specifies delivery requirements.
- A **QoS-0** ("at most once") message is fire-and-forget.
  - For example, a notification from a doorbell may only matter when immediately delivered.
- With **QoS-1** ("at least once"), the broker stores messages on disk and retries until clients have acknowledged their delivery.
  - (Possibly with duplicates.) It's usually worth ensuring error messages are delivered, even with a delay.
- **QoS-2** ("exactly once") messages have a second acknowledgement round-trip, to ensure that **non-idempotent messages** can be delivered exactly once.



# QoS: good to know

- The QoS flows between a publishing and subscribing client are two different things and QoS can be different.
  - That means the QoS level can be different from client A, who publishes a message, and client B, who receives the published message.
  - If client B has subscribed to the broker with QoS 1 and client A sends a QoS 2 message, it will be received by client B with QoS 1. And of course it could be delivered more than once to client B, because QoS 1 only guarantees to deliver the message at least once.
- Between the sender and the broker the QoS is defined by the sender.



# QoS: Best Practice

- Use QoS 0 when ...
  - **You have a complete or almost stable connection between sender and receiver.** A classic use case is when connecting a test client or a front end application to a MQTT broker over a wired connection.
  - **You don't care if one or more messages are lost once a while.** That is sometimes the case if the data is not that important or will be send at short intervals, where it is okay that messages might get lost.
- Use QoS 1 when ...
  - **You need to get every message and your use case can handle duplicates.** The most often used QoS is level 1, because it guarantees the message arrives at least once. Of course your application must be tolerating duplicates and process them accordingly.
  - **You can't bear the overhead of QoS 2.** Of course QoS 1 is a lot fast in delivering messages without the guarantee of level 2.
- Use QoS 2 when ...
  - **It is critical to your application to receive all messages exactly once.** This is often the case if a duplicate delivery would do harm to application users or subscribing clients. You should be aware of the overhead and that it takes a bit longer to complete the QoS 2 flow.

# Retained Messages!!!

- A retained message is a normal MQTT message **with the retained flag set to true. The broker will store the last retained message and the corresponding QoS for that topic**
  - Each client that subscribes to a topic pattern, which matches the topic of the retained message, will receive the message immediately after subscribing.
  - **For each topic only one retained message will be stored by the broker.**
- The subscribing client doesn't have to match the exact topic, it will also receive a retained message if it subscribes to a topic pattern including wildcards.
  - For example client A publishes a retained message to myhome/livingroom/temperature and client B subscribes to myhome/# later on. **Client B will receive this retained message directly after subscribing.**
  - In other words a retained message on a topic **is the last known good value**, because it doesn't have to be the last value, but it certainly is the last message with the retained flag set to true.
- Retained messages can help newly subscribed clients to get a status update immediately after subscribing to a topic and don't have to wait until a publishing clients send the next update.
- **Warning:** a retained message has nothing to do with a persistent session of any client

# Persistent session

- A persistent session saves all information relevant for the client on the broker. The session is identified by the **clientId** provided by the client on connection establishment
- So what will be stored in the session?
  - Existence of a session, even if there are no subscriptions
  - All subscriptions
  - All messages in a Quality of Service (QoS) 1 or 2 flow, which are not confirmed by the client
  - All new QoS 1 or 2 messages, which the client missed while it was offline
  - All received QoS 2 messages, which are not yet confirmed to the client
  - That means even if the client is offline all the above will be stored by the broker and are available right after the client reconnects.
- Persistent session on the client side
  - Similar to the broker, each MQTT client must store a persistent session too. So when a client requests the server to hold session data, it also has the responsibility to hold some information by itself:
  - All messages in a QoS 1 or 2 flow, which are not confirmed by the broker
  - All received QoS 2 messages, which are not yet confirmed to the broker

# “Will” message

- When clients connect, they can specify an optional “will” message, to be delivered if they are unexpectedly disconnected from the network.
  - (In the absence of other activity, a 2-byte ping message is sent to clients at a configurable interval.)
- This “last will and testament” can be used to notify other parts of the system that a node has gone down.

MQTT-Packet:	
CONNECT	
contains:	Example
clientId	“client-1”
cleanSession	true
username (optional)	“hans”
password (optional)	“letmein”
lastWillTopic (optional)	“/hans/will”
lastWillQos (optional)	2
lastWillMessage (optional)	“unexpected exit”
lastWillRetain (optional)	false
keepAlive	60

WHEN?

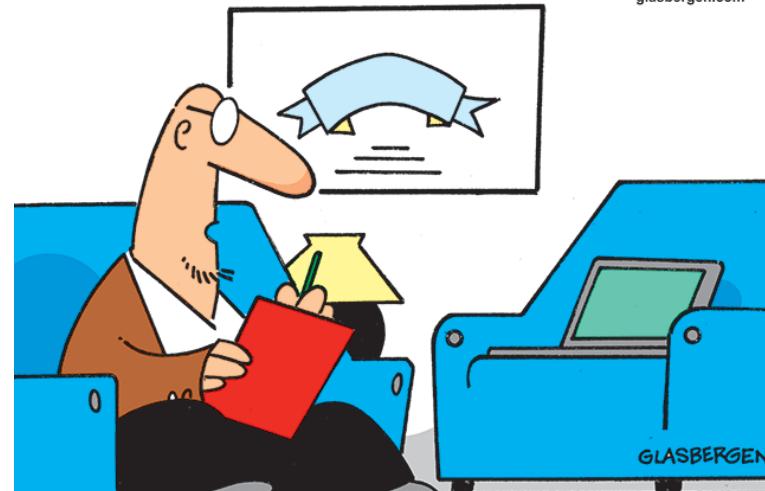
# MQTT Keep alive

- The keep alive functionality assures that the connection is still open and both broker and client are connected to one another. Therefore the client specifies a time interval in seconds and communicates it to the broker during the establishment of the connection.
  - The interval is the longest possible period of time which broker and client can endure without sending a message.
  - If the broker doesn't receive a PINGREQ or any other packet from a particular client, it will close the connection and send out the last will and testament message (if the client had specified one).
- Good to Know
  - The MQTT client is responsible of setting the right keep alive value.
  - The maximum keep alive is 18h 12min 15 sec.
  - If the keep alive interval is set to 0, the keep alive mechanism is deactivated.

# A few words on security

- MQTT has the option for Transport Layer Security (TLS) encryption.
- MQTT also provides username/password authentication with the broker.
  - Note that the password is transmitted in clear text. Thus, be sure to use TLS encryption if you are using authentication.

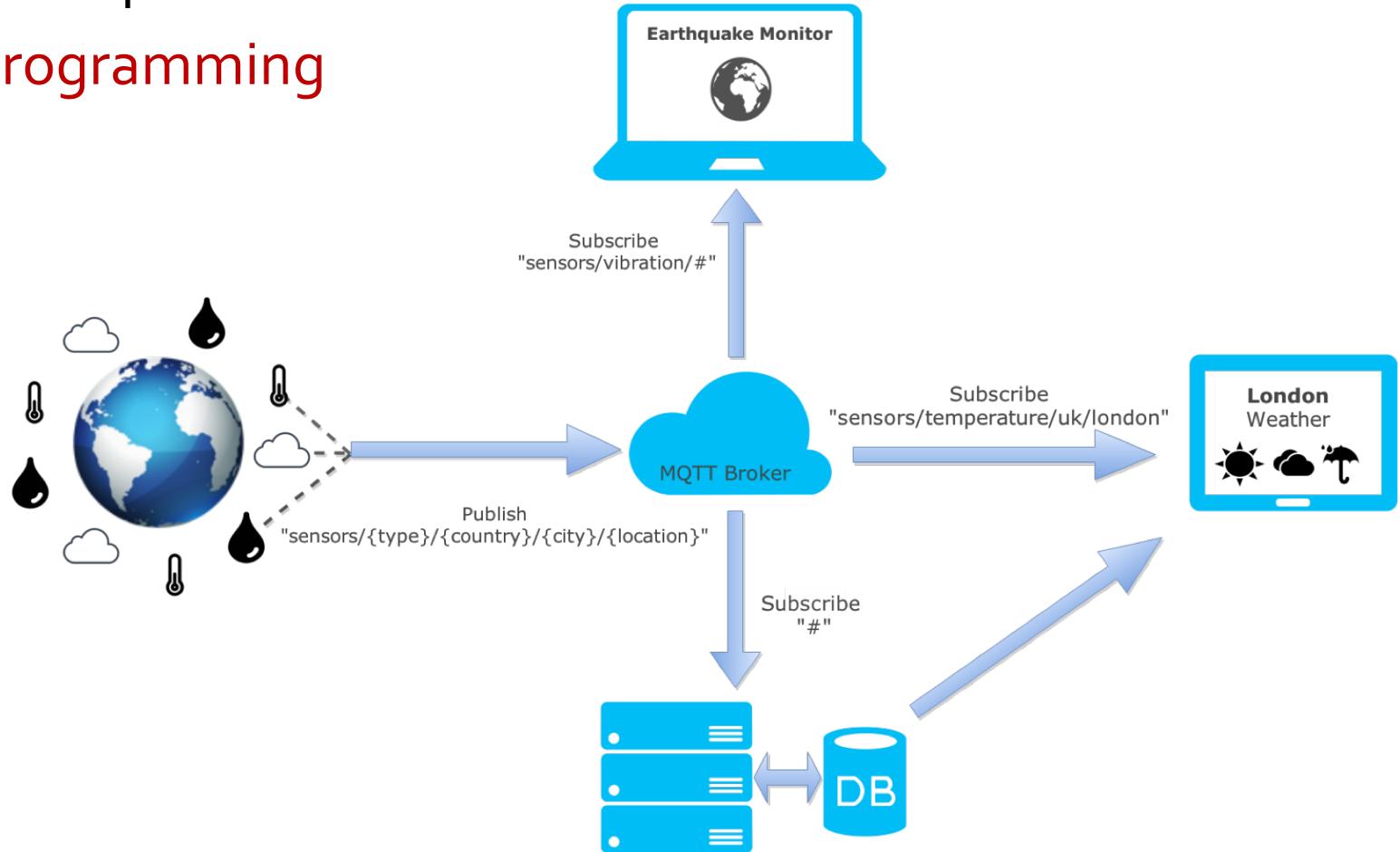
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glasbergen.com



"It's not just you. We're all insecure in one way or another."

# MQTT

- Basic concepts
- Basic programming

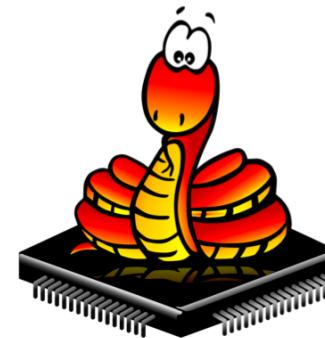


# Warning: Python vs Micropython

- The MQTT available versions for Python and MicroPython are slightly different.
- In the following we will see information about both cases.
- MicroPython is intended for constrained environments, in particular, microcontrollers, which have orders of magnitude less performance and memory than "desktop" systems on which Python3
- Basically remember that, when using the LoPy you have to use the MicroPython version of MQTT



vs.



# Software available



- Brokers:
  - <http://mosquitto.org/>
  - <http://www.hivemq.com/>
- A complete list here:  
<https://github.com/mqtt/mqtt.github.io/wiki/servers>
- Tools
  - <https://github.com/mqtt/mqtt.github.io/wiki/tools>



# “Sandboxes” for brokers

- [test.mosquitto.org](http://test.mosquitto.org)

- <http://test.mosquitto.org/>

- [iot.eclipse.org](https://iot.eclipse.org/getting-started#sandboxes)

- <https://iot.eclipse.org/getting-started#sandboxes>

- [broker.hivemq.com](http://www.hivemq.com/try-out/)

- <http://www.hivemq.com/try-out/>
  - <http://www.mqtt-dashboard.com/>

- Ports:

- standard: 1883
  - encrypted: 8883

Server	Broker	Port	WebSocket
iot.eclipse.org	Mosquitto	1883 / 8883	n/a
broker.hivemq.com	HiveMQ	1883	8000
test.mosquitto.org	Mosquitto	1883 / 8883 / 8884	8080 / 8081
test.mosca.io	mosca	1883	80
broker.mqttdashboard.com	HiveMQ	1883	

# Software available: clients



## ○ Clients

- **Eclipse Paho Python** (originally the mosquitto Python client)

<http://www.eclipse.org/paho/>

- Documentation: <https://pypi.python.org/pypi/paho-mqtt>
- or: <http://www.eclipse.org/paho/clients/python/docs/>
- Source: <https://github.com/eclipse/paho.mqtt.python>

## ○ Web Clients

- <https://www.hivemq.com/blog/seven-best-mqtt-client-tools>
- <http://www.hivemq.com/demos/websocket-client/>

## ○ A complete list:

- <https://github.com/mqtt/mqtt.github.io/wiki/libraries>

# Paho MQTT Python client: general usage flow



The general usage flow is as follows:

- Create a client instance
- Connect to a broker using one of the `connect*()` functions
- Call one of the `loop*()` functions to maintain network traffic flow with the broker
- Use `subscribe()` to subscribe to a topic and receive messages
- Use `publish()` to publish messages to the broker
- Use `disconnect()` to disconnect from the broker

# Example 1: the simplest subscriber



```
# File: example1.py

import paho.mqtt.client as mqtt

THE_BROKER = "test.mosquitto.org"
THE_TOPIC = "$SYS/#"

# The callback for when the client receives a CONNACK response from the server.
def on_connect(client, userdata, flags, rc):
    print("Connected to ", client._host, "port: ", client._port)
    print("Flags: ", flags, "return code: ", rc)

    # Subscribing in on_connect() means that if we lose the connection and
    # reconnect then subscriptions will be renewed.
    client.subscribe(THE_TOPIC)

# The callback for when a PUBLISH message is received from the server.
def on_message(client, userdata, msg):
    print(msg.topic+" "+str(msg.payload))

client = mqtt.Client()
client.on_connect = on_connect
client.on_message = on_message

client.connect(THE_BROKER, 1883, 60)

# Blocking call that processes network traffic, dispatches callbacks and
# handles reconnecting.
client.loop_forever()
```

# Example 1: output

```
paho-code:pietro$ python example1.py
('Connected to ', 'test.mosquitto.org', 'port: ', 1883)
('Flags: ', {'session present': 0}, 'return code: ', 0)
$SYS/broker/connection/ks.ral.me.rnic/state 0
$SYS/broker/connection/Salem2.Public_Bridge/state 1
$SYS/broker/connection/RPi_MQTT_GESRV.bridgeTestMosquittoOrg/state 1
$SYS/broker/connection/br-john-jane/state 1
$SYS/broker/connection/cell_controller.bridge-01/state 1
$SYS/broker/connection/OpenWrt1504793280.test-mosquitto-org/state 1
$SYS/broker/connection/(none).test/state 0
$SYS/broker/connection/jrojoo-All-Series.test-mqtt-org/state 0
$SYS/broker/connection/archer.hive-archer/state 1
$SYS/broker/connection/MD-FelipeCoutto.test_mosquitto/state 1
$SYS/broker/connection/raspberrypi.snr-mqtt-bridge/state 0
$SYS/broker/connection/LAPTOP-TCM0862P.bridge-test-GSR01/state 0
...
...
```

# Paho MQTT Python client: connect



```
connect(host, port=1883, keepalive=60, bind_address="")
```

- The broker acknowledgement will generate a callback (on\_connect).
- Return Codes:
  - 0: Connection successful
  - 1: Connection refused – incorrect protocol version
  - 2: Connection refused – invalid client identifier
  - 3: Connection refused – server unavailable
  - 4: Connection refused – bad username or password
  - 5: Connection refused – not authorised
  - 6-255: Currently unused.

# Paho MQTT Python client: pub/sub



## subscribe(topic, qos=0)

- e.g., subscribe("my/topic", 2)
- E.g., subscribe([("my/topic", 0), ("another/topic", 2)])
- on\_message(client, userdata, message) Called when a message has been received on a topic that the client subscribes to.

## publish(topic, payload=None, qos=0, retain=False)

# Example 1: the simplest subscriber... modified



```
# File: example1.py

import paho.mqtt.client as mqtt

THE_BROKER = "test.mosquitto.org"
THE_TOPIC = "$SYS/#"

# The callback for when the client receives a CONNACK response from the server.
def on_connect(client, userdata, flags, rc):
    print("Connected to ", client._host, "port: ", client._port)
    print("Flags: ", flags, "return code: ", rc)

    # Subscribing in on_connect() means that if we lose the connection and
    # reconnect then subscriptions will be renewed.
    client.subscribe(THE_TOPIC)

# The callback for when a PUBLISH message is received from the server.
def on_message(client, userdata, msg):
    print(msg.topic+" "+str(msg.payload))

client = mqtt.Client()
client.on_connect = on_connect
client.on_message = on_message

client.connect(THE_BROKER, 1883, 60)

# Blocking call that processes network traffic, dispatches callbacks and
# handles reconnecting
client.loop_forever()
```

# Example 1: output



```
paho-code:pietro$ python example1.py  
paho-code:pietro$
```



**What happened??**

# Paho MQTT Python client: Network loop



```
loop(timeout=1.0)
```

- Call regularly to process network events. This call waits in select() until the network socket is available for reading or writing, if appropriate, then handles the incoming/outgoing data.
- This function **blocks** for up to **timeout** seconds.
- timeout must not exceed the keepalive value for the client or your client will be regularly disconnected by the broker.
- **Better to use the following two methods**

```
loop_start() / loop_stop()
```

- These functions implement a threaded interface to the network loop.
- Calling `loop_start()` once, before or after `connect()`, runs a thread in the background to call `loop()` automatically. This frees up the main thread for other work that may be blocking.
- This call also handles reconnecting to the broker. For example:

```
mqttc.connect("iot.eclipse.org")
mqttc.loop_start()
while True:
    temperature = sensor.blocking_read()
    mqttc.publish("paho/temperature", temperature)
```

- Call `loop_stop()` to stop the background thread.

```
loop_forever()
```

- This is a **blocking** form of the network loop and will not return until the client calls `disconnect()`. It automatically handles reconnecting.

# Example 2: subscriber with loop\_start/loop\_stop

```
# File: example3.py

import sys
import time

import paho.mqtt.client as mqtt

THE_BROKER = "test.mosquitto.org"
THE_TOPIC = "$SYS/broker/load/bytes/#"

def on_connect(mqttc, obj, flags, rc):
    print("Connected to ", mqttc._host, "port: ", mqttc._port)
    mqttc.subscribe(THE_TOPIC, 0)

def on_message(mqttc, obj, msg):
    global msg_counter
    print(msg.topic+" "+str(msg.qos)+" "+str(msg.payload))
    msg_counter+=1

def on_subscribe(mqttc, obj, mid, granted_qos):
    print("Subscribed: ", mid, "granted QoS: ", granted_qos)

mqttc = mqtt.Client()
mqttc.on_message = on_message
mqttc.on_connect = on_connect
mqttc.on_subscribe = on_subscribe

mqttc.connect(THE_BROKER, keepalive=60)

msg_counter = 0
mqttc.loop_start()
while msg_counter < 10:
    time.sleep(0.1)
mqttc.loop_stop()
print msg_counter
```



```
paho-code:pietro$ python example3.py
('Connected to ', 'test.mosquitto.org', 'port: ', 1883)
('Subscribed: ', 1, 'granted QoS: ', (0,))
$SYS/broker/load/bytes/received/1min 0 489527.05
$SYS/broker/load/bytes/received/5min 0 491792.65
$SYS/broker/load/bytes/received/15min 0 495387.48
$SYS/broker/load/bytes/sent/1min 0 4133472.81
$SYS/broker/load/bytes/sent/5min 0 3515397.37
$SYS/broker/load/bytes/sent/15min 0 2885966.59
$SYS/broker/load/bytes/received/1min 0 483622.23
$SYS/broker/load/bytes/sent/1min 0 3766302.58
$SYS/broker/load/bytes/received/5min 0 490441.96
$SYS/broker/load/bytes/sent/5min 0 3458734.24
$SYS/broker/load/bytes/received/15min 0 494888.07
$SYS/broker/load/bytes/sent/15min 0 2874493.79
12
```

# Example 3: very basic periodic producer



```
# File: example4.py

import sys
import time
import random

import paho.mqtt.client as mqtt

THE_BROKER = "test.mosquitto.org"
THE_TOPIC = "PMtest/rndvalue"

mqttc=mqtt.Client()
mqttc.connect(THE_BROKER, 1883, 60)

mqttc.loop_start()

while True:
    mqttc.publish(THE_TOPIC, random.randint(0, 100))
    time.sleep(5)

mqttc.loop_stop()
```

Generates a new data every 5 secs

```
paho-code:pietro$ python example2_4.py
('Connected to ', 'test.mosquitto.org', 'port: ', 1883)
('Subscribed: ', 1, 'granted QoS: ', (0,))
('Received ', '61', 'with topic ', u'PMtest/rndvalue')
('Received ', '62', 'with topic ', u'PMtest/rndvalue')
('Received ', '11', 'with topic ', u'PMtest/rndvalue')
('Received ', '79', 'with topic ', u'PMtest/rndvalue')
...
...
```

Output obtained with a modified version of example2.  
**Which parts of that code had to be modified?**

# Example 4: Pub/Sub with JSON



```
# File: example5_prod.py  
  
...  
  
mqttc.loop_start()  
  
while True:  
    # Getting the data  
    the_time = time.strftime("%H:%M:%S")  
    the_value = random.randint(1,100)  
    the_msg={ 'Sensor': 1, 'C_F': 'C',  
              'Value': the_value, 'Time': the_time}  
  
    the_msg_str = json.dumps(the_msg)  
  
    mqttc.publish(THE_TOPIC, the_msg_str)  
    time.sleep(5)  
  
mqttc.loop_stop()
```

## Producer

```
# File: example5_cons.py  
  
...  
  
# The callback for when a PUBLISH message is received  
from the server.  
  
def on_message(client, userdata, msg):  
    print(msg.topic+" "+str(msg.payload))  
  
    themsg = json.loads(str(msg.payload))  
  
    print("Sensor "+str(themsg['Sensor'])+" got value "+  
          str(themsg['Value'])+" "+themsg['C_F']+  
          " at time "+str(themsg['Time']))
```

## Consumer



```
paho-code:pietro$ python example5-cons.py  
Connected with result code 0  
PMtest/jsonvalue {"Time": "12:19:30", "Sensor": 1, "Value": 33, "C_F": "C"}  
Sensor 1 got value 33 C at time 12:19:30  
PMtest/jsonvalue {"Time": "12:19:35", "Sensor": 1, "Value": 11, "C_F": "C"}  
Sensor 1 got value 11 C at time 12:19:35
```



# MQTT with MicroPython

- Import the library

```
from mqtt import MQTTClient
```

- Creating a client:

```
MQTTclient(client_id, server, port=0, user=None,  
password=None, keepalive=0, ssl=False, ssl_params={})  
e.g., client = MQTTClient("dev_id", "10.1.1.101", 1883)
```

- The various calls:

- `connect(clean_session=True):`

- `publish(topic, msg, retain=False, qos=0):`

- `subscribe(topic, qos=0):`

- `set_callback(self, f):`

- `wait_msg():`

- Wait for a single incoming MQTT message and process it. Subscribed messages are delivered to a callback previously set by `.set_callback()` method. Other (internal) MQTT messages processed internally.

- `check_msg():`

- Checks whether a pending message from server is available. If not, returns immediately with None. Otherwise, does the same processing as `wait_msg`.

# MicroPython: a simple publisher



```
# file: a_simple_pub.py

from mqtt import MQTTClient
import pycom
import sys
import time

import ufun

wifi_ssid = 'THE_NAME_OF_THE_AP'
wifi_passwd = ''
broker_addr = 'iot.eclipse.org'
dev_id = 'THE_NAME_OF_THE_DEVICE'

def settimeout(duration):
    pass

def get_data_from_sensor(sensor_id="RAND"):
    if sensor_id == "RAND":
        return ufun.random_in_range()

ufun.connect_to_wifi(wifi_ssid, wifi_passwd)

client = MQTTClient(dev_id, broker_addr, 1883)

print ("Connecting to broker: " + broker_addr)
try:
    client.connect()
except OSError:
    print ("Cannot connect to broker: " + broker_addr)
    sys.exit()
print ("Connected to broker: " + broker_addr)

print('Sending messages...')
while True:
    # creating the data
    the_data = get_data_from_sensor()
    # publishing the data
    client.publish('THE_TOPIC_TO_BE_USED', str(the_data))
    time.sleep(1)
```

# MicroPython: a simple subscriber



```
from mqtt import MQTTClient
import pycom
import sys
import time

import ufun

wifi_ssid = 'THE_NAME_OF_THE_AP'
wifi_passwd = ''
broker_addr = 'iot.eclipse.org'
dev_id = 'THE_NAME_OF_THE_DEVICE'

def settimeout(duration):
    pass

def on_message(topic, msg):
    print("Received msg: ", str(msg), "with topic: ", str(topic))

ufun.connect_to_wifi(wifi_ssid, wifi_passwd)

client = MQTTClient(dev_id, broker_addr, 1883)
client.set_callback(on_message)

print ("Connecting to broker: " + broker_addr)
try:
    client.connect()
except OSError:
    print ("Cannot connect to broker: " + broker_addr)
    sys.exit()
print ("Connected to broker: " + broker_addr)

client.subscribe('THE_TOPIC_TO_BE_USED')

print('Waiting messages...')
while 1:
    client.check_msg()
```