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# CREATING A BRIDGE OF BROKERS FOR MESSAGE QUEUE TELEMETRY TRANSPORT (MQTT) PROTOCOL

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**Abstract.** As we all know that, all soft computing devices are able to connect with each other through internet. This is calling as internet of things (IoT) [4],[8]. IoT uses different protocols to exchange information among various devices. Different protocols are available i.e., constrained application protocol (CoAP), message queue telemetry transport (MQTT), Advanced message queuing protocol (AMQP) and so on. These protocols are intended for constrained devices i.e., devices with low RAM size and processor. MQTT is a light weight protocol with publish/subscribe communication model. MQTT uses a broker to provide communication among devices which are subscribed to the broker. Various brokers are available in the market like mosquito, RabbitMQ and so on. These brokers allow to receive and send information, only the devices which have subscribed to a particular broker. The devices which have subscribed to other broker are unable establish communication. If devices would like make communication with the devices connected with other brokers is required to make a group or bridge of brokers.

## Introduction

Internet of Things (IoT) [7],[8] is a way of connecting everything to the internet. All these things/devices are connected with each other through internet and exchange information. These devices are constrained in terms of resources like less RAM size and lower processing speeds. All these devices have low computational power, so they require special communication protocols to establish communication. Constrained application protocol (CoAP), Message queue telemetry transport (MQTT), Advanced message queuing protocol (AMQP) and DDS. These protocols are being used at application layer level. Among these protocols some may follow client/server communication model or publish/subscribe model. For example, CoAP follows client/server and MQTT follows publish/subscribe communication model.

Message queue telemetry transport (MQTT) [4] is a light weight communication protocol, it follows publish/subscribe communication model. MQTT protocols requires intermediary

application to create communication among various devices. Various brokers are existing in the market like mosquitto, RabbitMQ and emqx.

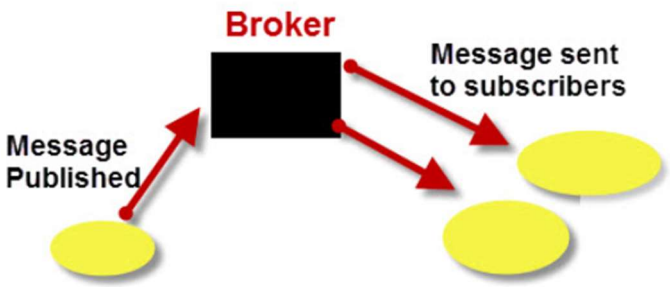


FIGURE 1: MQTT Publish Subscribe Model

MQTT [4] works as TV broad casting mechanism. Each program played on a specific channel by the TV broadcasters, users are required to tune a particular channel so that they can view the required program. Various topics are need to be created on broker. Clients who send messages are called as publishers and who receives messages are calling as subscribers. Subscribers are need to subscribe to a particular topic so that they can receive messages which are published on the same topic by the publishers. MQTT protocol uses TCP hand shake protocol to establish connection among clients. Transmission control protocol (TCP) is reliable since it is connection oriented.

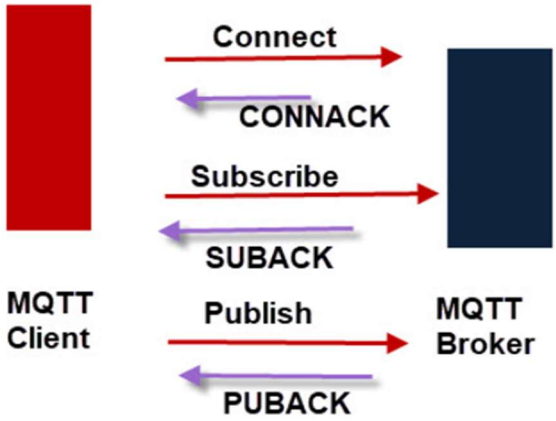


FIGURE 2. MQTT Message flow

As TCP is connection oriented, clients will receive acknowledgements after each communication. Every client has a unique name or client id. If any new connection will try to make a connection with the existing client name, connection will be lost. All clients need to connect to the broker then only they can able to communicate with each other. If clients of different brokers need to communicate with other broker's clients, then brokers must be communicated with other.

## Related Study

Authors have explained remote patient monitoring in [1], This system monitors pulse oxymeter and electrocardiogram (ECG) readings. Message queue telemetry transport (MQTT) protocol being used as a communication protocol to read sensor readings. The clients who have subscribed to a particular topic, only those clients receive the information. Others who have not subscribed to that topic will not receive messages from the sensors.

Paper [2] explains the real time remote monitoring. It reads electrocardiogram (ECG) recordings remotely. To read this information authors have used MQTT (Message queue telemetry transport) protocol. It has tested in LAN (Local Area Network) and WAN (Wide Area Networks) [5], [7]. They have created a topic on MQTT broker. All the clients who wish to receive information need to subscribe to that topic.

In [3] authors explained how to read blood pressure (BP), blood oxygen levels, body weight and body temperature with different sensors. All the data will reach to the central point from these sensors. For communication authors have used (RFID) radio frequency identification and (MQTT) message queue telemetry transport protocol. Through MQTT protocols clients will receive information from the sensors.

[4] paper has explained home automation system using MQTT protocol. Authors have explained how to control home appliances remotely using MQTT protocol. Home appliances and control unit must have connected to the same topic on the MQTT broker. They have used mosquito as the MQTT broker. But if others would like to control the home appliance, they are unable to do it.

## Proposed Model

MQTT bridge allows to increase scalability. If there are two brokers in the network i.e., brokers B1 and B2, clients of B1 are unable subscribe the topics on B2 and clients of B2 are unable to subscribe to topics on B1. If it needs to be happened, we have to create a bridge of brokers.

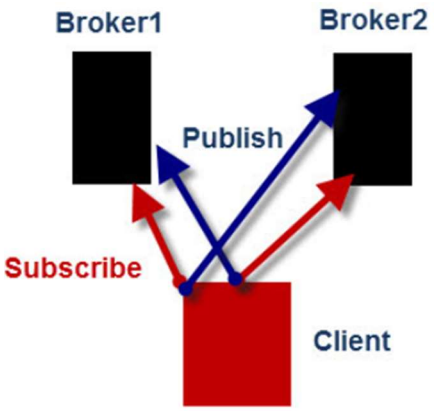


FIGURE 3: MQTT Bridge

When we group a bridge of brokers, one of the broker acts as bridge or server. Other brokers act as a normal client. Figure 3 depicts MQTT [9] bridge, it has two brokers and all the clients of two brokers can able to communicate. We need to configure any one of the brokers as a server. While configuring the server we must mention the IP address and port number of server broker. It also needs to mention the client's name and topic names which are going to be publish message or subscribe to. We must mention all the details as follows

topic topic-pattern direction qos local/remote prefix

it uses in, out and both as directions. Out means, writes messages on to subscribers. In means receive messages from publishers. Both means, they can able to receive and send messages. QOS indicates quality of service levels. MQTT provides three types of quality of services i.e QOS1, QOS2 and QOS3.

```
#connection <name>

connection bridge-01
address 192.168.1.184:1883

topic # out 0
topic # in 0
```

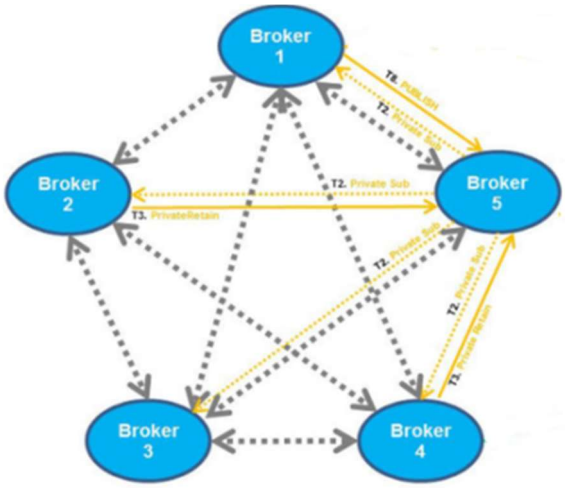


FIGURE 4: MQTT broker cluster

The above figure is MQTT [4] broker cluster, which has many numbers of brokers so that it increases scalability. When we use a cluster architecture, we must need to concentrate on adjusting the clients to other brokers if any one of the brokers misfunctions. We must also identify a good technique to monitor the total network. As the number of brokers increasing in the network, it increases the complexity.

**The Result Analysis**

We have done some experiments. Where we sent different number of messages through different brokers. n=10k means 10000 messages to send per client, c=100 means 100 clients to start. MsgSize=1000bytes, QoS=2.

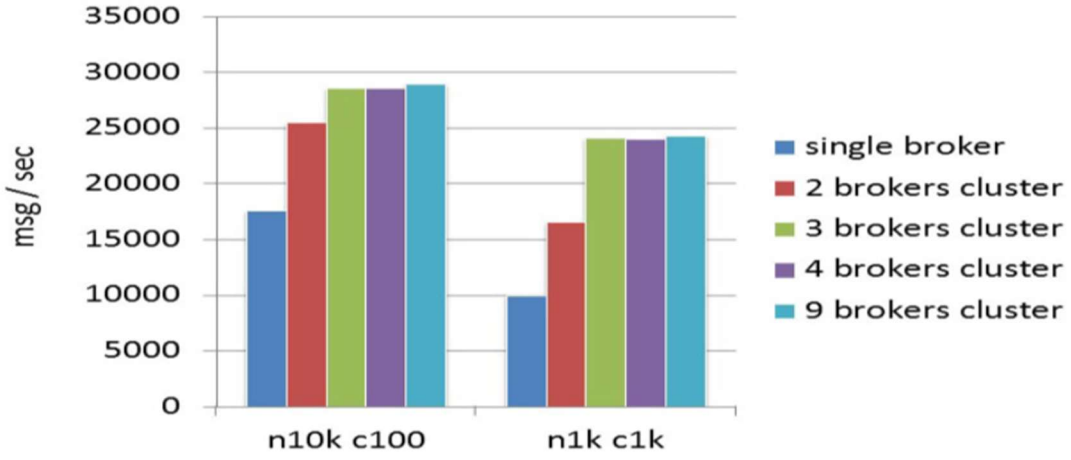

FIGURE 5: Mean bandwidth

## Conclusion and Future Scope

We can able to create a cluster of brokers with many brokers. But there is a problem with cluster is, there is no way of monitoring the network. If any one of the brokers has failed, the total network might get down. We can solve this problem with the help of software defined network (SDN) [9], [11]. With the help of SDN we can monitor the network, if any broker failed it adjust the clients to other brokers.

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