

## Introduction

MQTT is a commonly used protocol used for communicating between industrial devices.

In the RAPIX Lighting Control System, a Zone Controller can act as a MQTT Client.

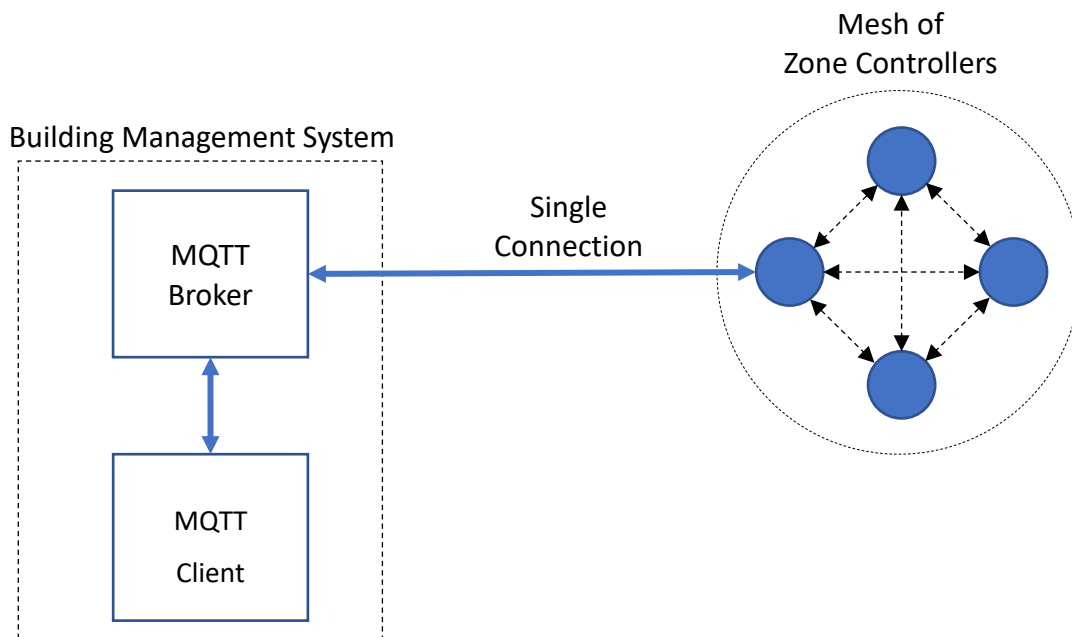
A full description of MQTT is beyond the scope of this document. Refer to the official MQTT specification at <https://mqtt.org/>.

This document describes of controlling and monitoring a RAPIX Lighting Control System using MQTT.

## RAPIX Support for MQTT

### System Architecture

The RAPIX Zone Controllers form a mesh to allow them to exchange information about zones and scenes, so they can all maintain a model of the whole system. Only a single Zone Controller needs to connect to the MQTT Broker to enable control and monitoring of the whole system.

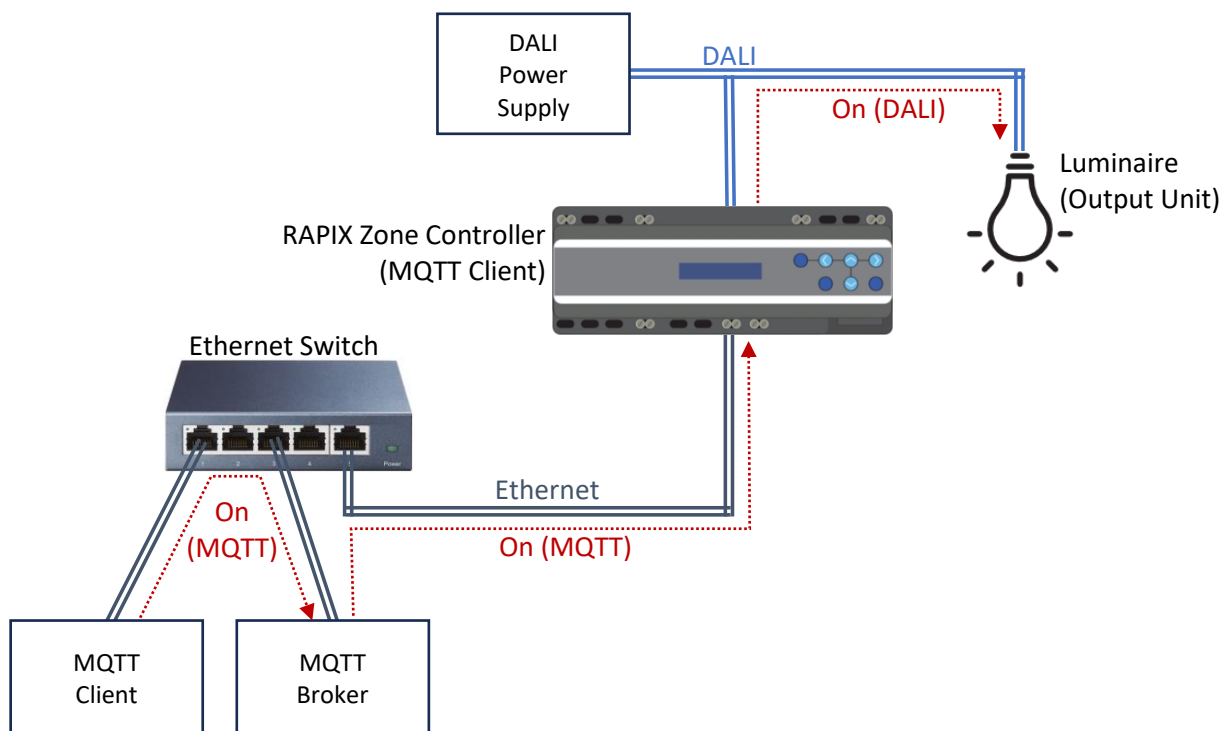


### ***Control and Monitoring***

An MQTT client can be used to control and monitor various aspects of the RAPIX system:

- Zones
- Scenes
- Flags
- Operating Properties

An example of an MQTT Client controlling a Luminaire via MQTT and RAPIX is shown below.



***MQTT Client controlling a luminaire via MQTT and RAPIX***

### MQTT Topics

The available MQTT topics are listed in the tables below.

The base of the topics is always “rapix” followed by a unique identifier for the project. This allows an MQTT Broker to work with more than one project.

#### Monitoring RAPIX

The messages shown in the table below are used for monitoring the status of a RAPIX system. **They are only published by a Zone Controller.** Other MQTT clients can subscribe to them as required.

Topic	Message	Retained
rapix/<id>/connected	0 = RAPIX is disconnected from broker 1 = RAPIX connected to broker	Yes
rapix/<id>/status/zone/<id>	<level>, <min level>,<max level>, <target level>,<colour>,<target colour>, <reserved>,<occupied>,<error>	Yes
rapix/<id>/status/scene/<id>	0 = not set 1 = set	Yes
rapix/<id>/status/flag/<group id>/<flag id>	0 = clear 1 = set	Yes
rapix/<id>/status/op_prop/<id>	<value>	Yes

#### Topics for monitoring RAPIX

#### Controlling RAPIX

MQTT Clients can publish the messages shown in the table below to control a RAPIX system. **The retained flag should not be set.** These messages are subscribed to by the Zone Controller.

Topic	Message	Retained
rapix/<id>/set/zone/<id>	off on <level> <level>, <fade time> <level>, <colour>, <fade time>	No
rapix/<id>/set/scene/<id>	0 = off 1 = set	No
rapix/<id>/set/flag/<group id>/<flag id>	0 = clear 1 = set	No
rapix/<id>/set/op_prop/< id>	<value>	No

#### Topics for controlling RAPIX

## Zones

### Controlling Zones

There are several options for controlling zones as shown in the table below.

Action	Message	Example
Turn Zone off	off	off
Turn Zone on	on	on
Set Zone level	<level>	127
Fade Zone to level over time	<level>, <fade time>	127,4
Fade Zone level and colour	<level>, <colour>, <fade time>	127,0x03FE0000000000,0

### ***Controlling RAPIX Zones***

### Zone Levels

The RAPIX Lighting Control System provides several options for how the Zone level scaling can be done to suit the requirements of the other MQTT clients. All messages that are used to control or monitor Zones will use a level scaled according to the selected option.

MQTT Scale	Purpose	Scaling
0 – 1	On/off control	0 = off 1 = on
0 – 100	Percentage control	0 = off 1 – 100 = 1% – 100%
0 – 254	DALI Level control	0 = off 1 – 254 = DALI Level 1 to 254
0 – 255	8-bit control	0 = off 1 – 255 = 0.4% to 100%
0 – 65535	16-bit control	0 = off 1 – 65535 = 0.4% to 100%

### ***Zone Level Scaling***

### Zone Fade Times

When a RAPIX Zone is set to a new level, a fade time can be used. This is the time taken for the level to transition from the current level to the new level. Fade times of 0 (instant) and 0.7 to 65535 seconds (18 hours) can be selected.

### Zone Colours

The Zone Colour can be controlled and monitored if the Zone contains DALI Type 8 devices (i.e. colour control).

In the MQTT messages, colour values are in hexadecimal (prefixed with “0x”), as shown in the table below:

Colour Type	Message	Example
Colour Temperature	0x0100000000CCCC Where: CCCC = colour temperature (K)	4000K = 0x0100000000FA0
RGB	0x03RRGGBB000000 Where: RR = Red (00 to FE) GG = Green (00 to FE) BB = Blue (00 to FE)	Red = 0x03FE0000000000 White = 0x03FEFEFE000000
RGBW	0x03RRGGBBWW0000 Where: RR = Red (00 to FE) GG = Green (00 to FE) BB = Blue (00 to FE) WW = White (00 to FE)	White = 0x03000000FE0000
XY	0x040000XXXXYYYY Where: XXXX = X component (0000 to FFFE) YYYY = Y component (0000 to FFFE)	White = 0x040000500D543A

### **Zone Colour Values**

### Zone Occupancy

A value of 0 means the Zone is unoccupied. A value of 1 means that it is occupied.

### Zone Error Status

RAPIX Zone Controllers can report the error status of Zones. The error status value is a bitfield as shown in the table below.

Bit-field Value	Name	Meaning
0x00	OK	Everything in the Zone is OK
0x01	LEVEL UNKNOWN	The level of some or all devices in the zone is unknown. <b>This is not necessarily an error.</b>
0x02	LAMP FAILURE	One or more devices has a lamp failure. Specifically, the DALI Query Status message reported "Lamp Failure".
0x04	DEVICE_FAILURE	One or more devices has an internal failure. Specifically, the DALI Query Status message reported "Control Gear Failure".
0x08	DEVICE MISSING	One or more devices in the Zone are not responding (but the DALI Line is OK).
0x10	DALI LINE FAILURE	One or more DALI Lines (which are part of the Zone) have a communication failure.
0x20	ZONE CONTROLLER COMMS FAILURE	One or more Zone Controllers (which are part of the Zone) is not communicating.
0x40	EM FAILURE	One or more Emergency Devices has a failure. Specifically, the Device Type 1 Query Failure Status message reported one or more of: <ul style="list-style-type: none"> <li>• Circuit Failure</li> <li>• Battery Duration failure or Battery Failure</li> <li>• Emergency Lamp Failure</li> <li>• Function/Duration Test max. delay exceeded</li> <li>• Function/Duration Test failed</li> </ul>
0x80	DEVICE_CONFLICT	One or more addresses has multiple devices

**\* Note: 0x indicates a hexadecimal value**

The simplest way to use the Error Status value is:

1. If the value is 0, all is OK
2. If the least significant bit is set, then the Zone Level is unknown / uncertain (this is not necessarily an error)
3. If any of the other bits are set, there is a failure

Examples:

Error Status = 17 = 0x11 = 0x10 + 0x01 (DALI Line Failure and Level Unknown)

Error Status = 70 = 0x46 = 0x40 + 0x04 + 0x02 (EM Failure, Device Failure and Lamp Failure)

## Configuring the MQTT settings using RAPIX Integrator

To configure the MQTT settings for the RAPIX Lighting Control System:

- Use RAPIX Integrator Software
- Select the Site tab:

**MQTT**

MQTT:  TCP/IP i

Id:

Zone Controller:

Broker Address:

Broker Port:

Username:

Password:

Zone Level Range:

### *MQTT Settings.*

The MQTT settings are described in the table below and are discussed in detail in the previous sections.

Setting	Purpose	Default Value
Id	A unique name to allow the Broker to distinguish between multiple projects. Spaces and slash characters should be avoided in the id.	Site Name
Zone Controller	The Zone Controller that will be the client. Avoid using the Zone Controller with the lowest IP Address, if possible, as it will be the “master” and will be the busiest of the Zone Controllers.	-
Broker Address	MQTT Broker URL or IP Address	-
Broker Port	MQTT Broker Port.	1883
Username	The (optional) username for the Zone Controller to use when connecting to the MQTT broker.	-
Password	The (optional) password for the Zone Controller to use when connecting to the MQTT broker.	-
Zone Level Range	The range that the MQTT clients will use for the Zone Level	254

### *MQTT Settings*

## Run-time Execution

After the configuration has been set using RAPIX Integrator software, it is saved to the Zone Controllers.

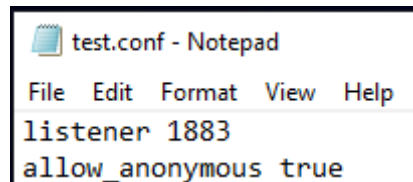
After the configuration has been transferred, the Zone Controller that was configured as the MQTT client will connect to the MQTT broker.

After that transfer, there is no need for RAPIX Integrator to remain open, connected to Zone Controllers, remain on site, and so on.

## Testing

A simple way to test the Zone Controller MQTT client on Windows is as follows:

1. Install the Mosquitto MQTT Broker from <https://mosquitto.org/download/>
2. In the folder where Mosquitto was installed (by default it will be C:\Program Files\mosquitto), create a configuration file "test.conf". The file contents should be as shown below.

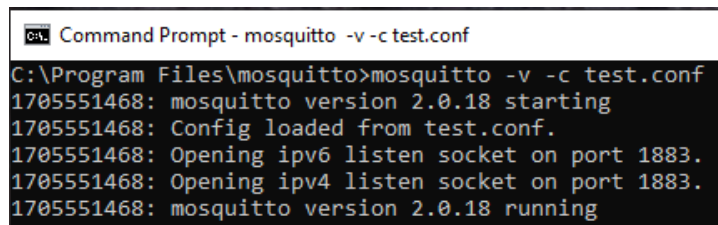


```
test.conf - Notepad
File Edit Format View Help
listener 1883
allow_anonymous true
```

**The Mosquitto Configuration File**

3. Run the Mosquitto Broker. The best way to do this for testing is to run it with "verbose" logging. It will be necessary for Mosquitto to use the configuration file, otherwise it will not accept connections from MQTT Clients outside of the computer. Open a command prompt, navigate to the Mosquitto installation folder, and type the command shown below.

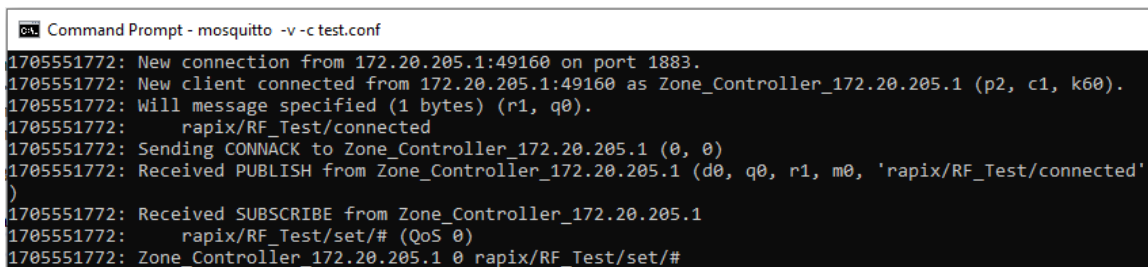
```
mosquitto -v -c test.conf
```



```
Command Prompt - mosquitto -v -c test.conf
C:\Program Files\mosquitto>mosquitto -v -c test.conf
1705551468: mosquitto version 2.0.18 starting
1705551468: Config loaded from test.conf.
1705551468: Opening ipv6 listen socket on port 1883.
1705551468: Opening ipv4 listen socket on port 1883.
1705551468: mosquitto version 2.0.18 running
```

**Command to start the Mosquitto Broker**

4. You may need to configure your firewall to allow Mosquitto to open the port.
5. Configure your RAPIX project to use the installed MQTT Broker.
6. Transfer the project to the Zone Controllers.
7. Once the Zone Controllers have loaded the new project and finished the DALI Line scans, the nominated Zone Controller will connect to the Broker. You will see the connection details in the command prompt window.



```
Command Prompt - mosquitto -v -c test.conf
1705551772: New connection from 172.20.205.1:49160 on port 1883.
1705551772: New client connected from 172.20.205.1:49160 as Zone_Controller_172.20.205.1 (p2, c1, k60).
1705551772: Will message specified (1 bytes) (r1, q0).
1705551772: rapix/RF_Test/connected
1705551772: Sending CONNACK to Zone_Controller_172.20.205.1 (0, 0)
1705551772: Received PUBLISH from Zone_Controller_172.20.205.1 (d0, q0, r1, m0, 'rapix/RF_Test/connected'
)
1705551772: Received SUBSCRIBE from Zone_Controller_172.20.205.1
1705551772: rapix/RF_Test/set/# (QoS 0)
1705551772: Zone_Controller_172.20.205.1 0 rapix/RF_Test/set/#
```

**Zone Controller connecting to the MQTT Broker**



8. Open another command prompt, and subscribe to all RAPIX “status” events as shown below.

```
mosquito_sub -h localhost -t rapix/Test/status/# -d
```

This is the IP address of the MQTT Broker.  
“localhost” = 127.0.0.1 (the local computer)

This is the name of your project,  
as per the MQTT configuration settings.

```
Command Prompt - mosquito_sub -h localhost -t rapix/Test/status/# -d
C:\Program Files\mosquitto>mosquitto_sub -h localhost -t rapix/Test/status/# -d
Client null sending CONNECT
Client null received CONNACK (0)
Client null sending SUBSCRIBE (Mid: 1, Topic: rapix/Test/status/#, QoS: 0, Options: 0x00)
Client null received SUBACK
Subscribed (mid: 1): 0
```

***Subscribing to all RAPIX events***

9. Change the level of a zone, and you will see the resulting MQTT message(s).

```
Command Prompt - mosquito_sub -h localhost -t rapix/Test/status/# -d
Client null received PUBLISH (d0, q0, r0, m0, 'rapix/Test/status/zone/9',
254,254,254,254,,,0,0)
```

***An MQTT message showing the changed status of Zone 9***

10. Open another command prompt, and publish a message to control a Zone as shown below.

```
mosquito_pub -h localhost -t rapix/Test/set/zone/9 -m on -d
```

This is the Zone number

This is the new Zone level or state

```
Command Prompt
C:\Program Files\mosquitto>mosquitto_pub -h localhost -t rapix/Test/set/zone/9 -m on -d
Client null sending CONNECT
Client null received CONNACK (0)
Client null sending PUBLISH (d0, q0, r0, m1, 'rapix/Test/set/zone/9', ... (2 bytes))
Client null sending DISCONNECT
```

***Publishing an MQTT message to turn Zone 9 on.***

11. You will see the Zone level change, and you will see a message in the other command prompt window (the one that subscribed to all status topics).

**Please note that Ozuno does not endorse the use of Mosquitto, nor does it provide technical support for the use of it.**

## Change History

Rev	Date	Updated By	Comment
1	17 Jan 2024	DS	First Release
2	22 Jan 2024	DS	Added details of username and password Explained the use of the “status” and “set” topics. Added system diagram.
3	19 Aug 2024	DS	Added details to Zone Error Status table.
4	22 Oct 2024	DS	Added explanation of the system architecture.

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### Contact Information

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