SmartPark

An easy bycicle park

Matteo De Francesco

Computer Engineering

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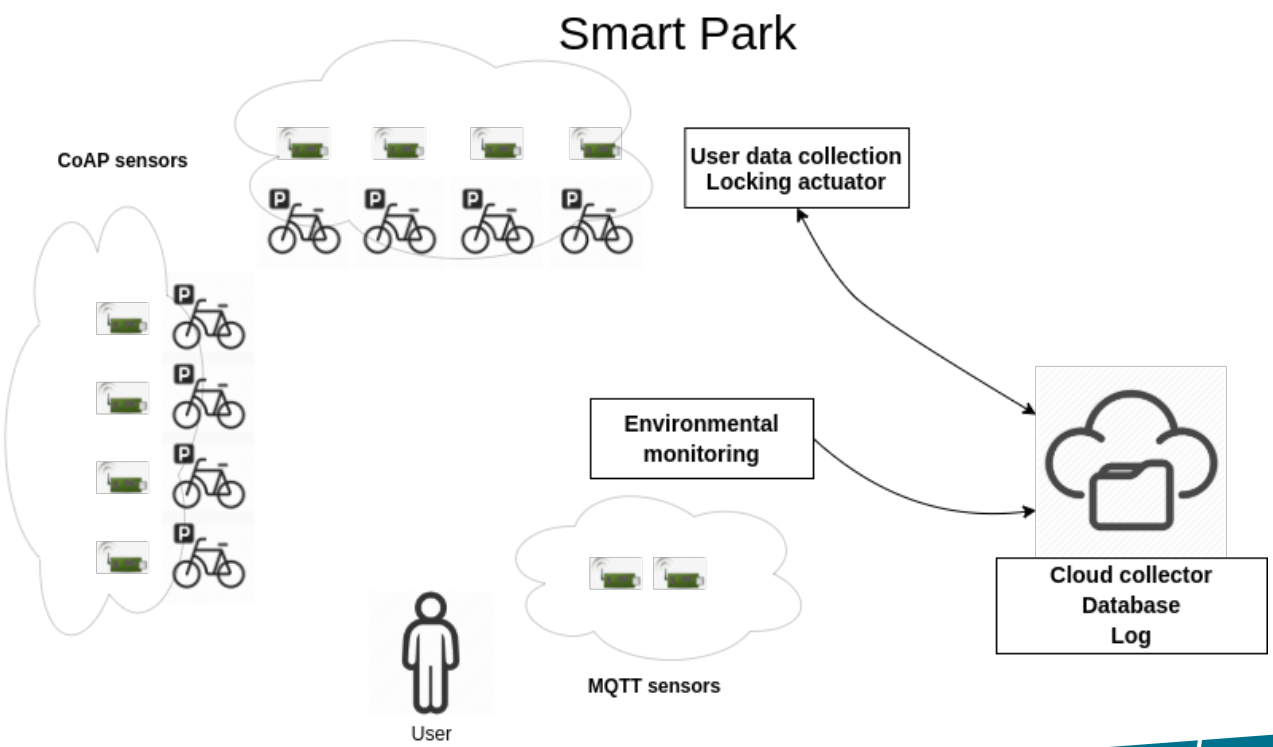
Università di Pisa

General overview

- SmartPark: a place where bycicle park gets easier



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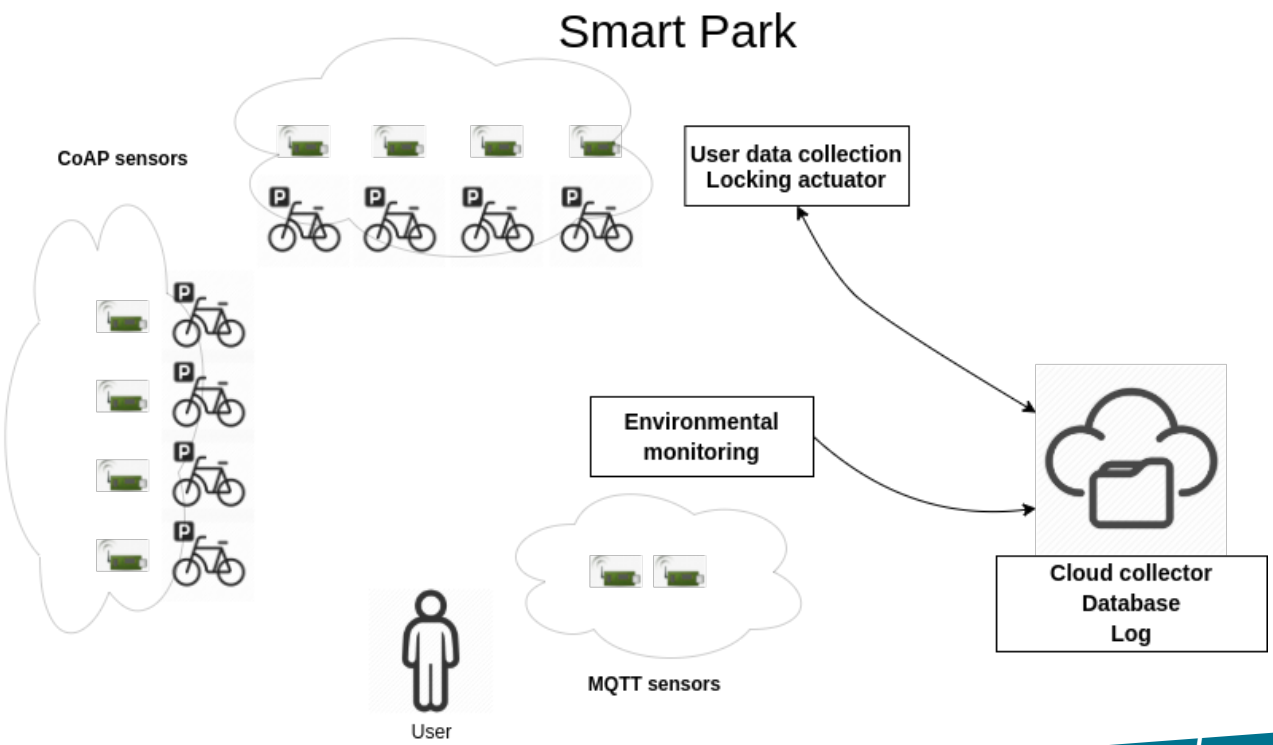
- Why need to bring a lock each time you go to work?



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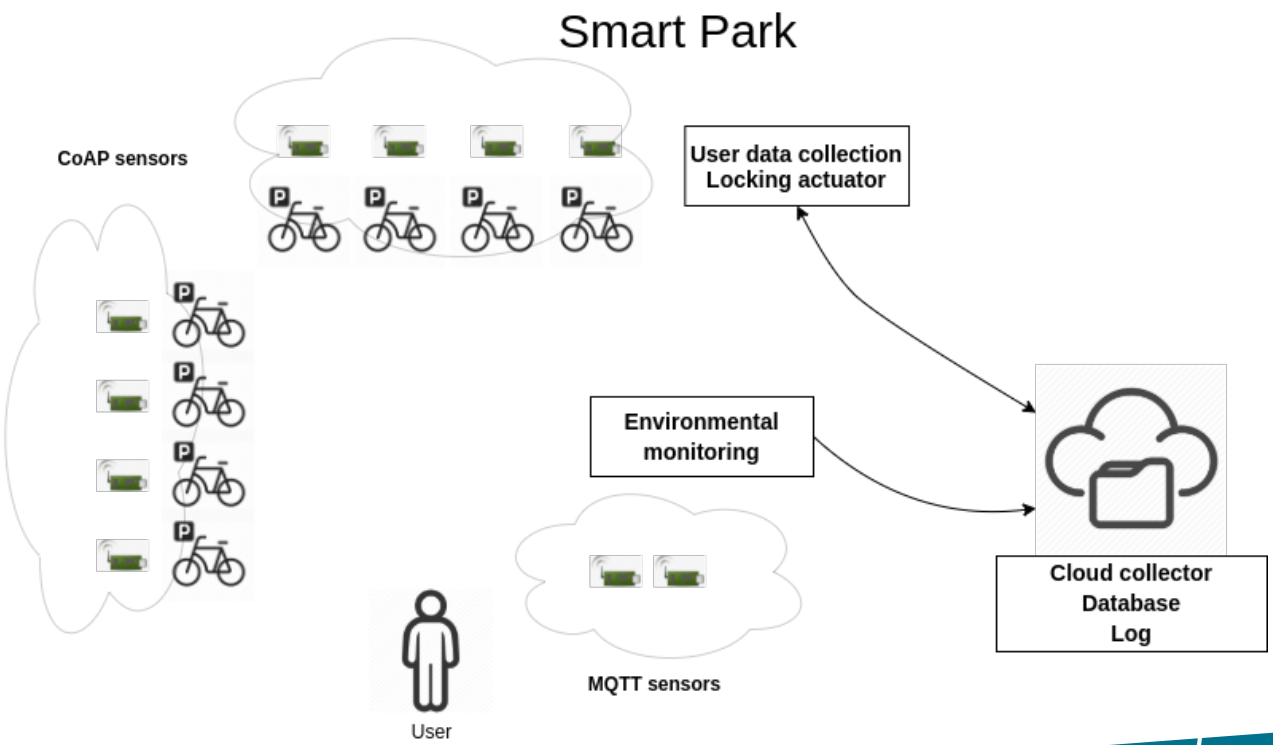
- SmartPark: a place where bycicle park gets easier
- Why need to bring a lock each time you go to work?
- With SmartPark this is not anymore a problem!



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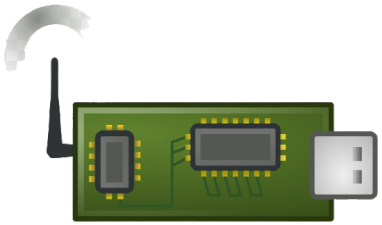

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- Cloud server send packets to the lock sensors to lock/unlock chain whenever a user is recognized
- Bycicle spots with sensors enabling user input name and password
- Central sensors collecting information about the weather
- Both type of sensors collects data which is sent to the cloud collector and stored

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- Upon receipt of the answer, the sensor enable/disable lock with respectively green/red leds

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- Instead the payload with information about temperature, umidity and actual weather is sent through another PROCESS_THREAD every 30 seconds

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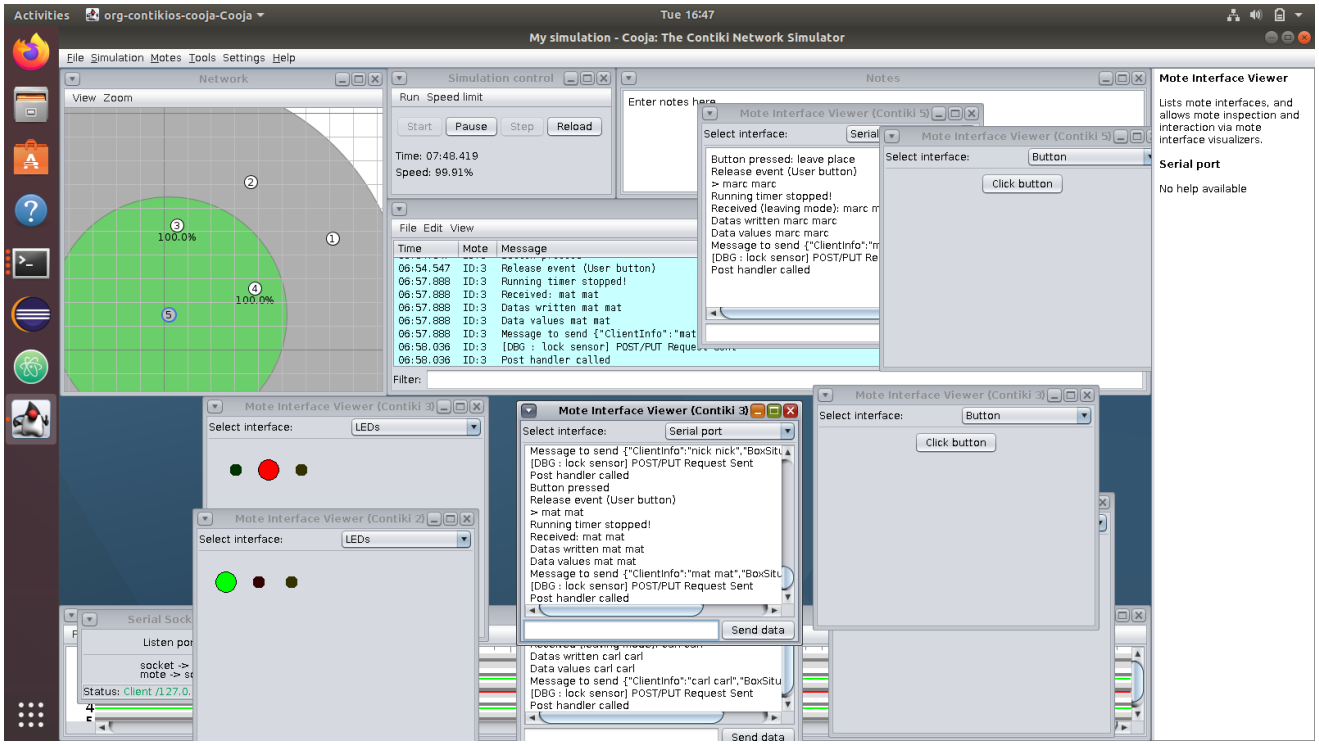
- Each time an update on the lock status is POST by the coap server or an MQTT update is received, a log of the respective database table is showed
- Data is stored inside *datacollector* database, with 2 tables, *coapsensors* and *mqttsensors*

Simulation



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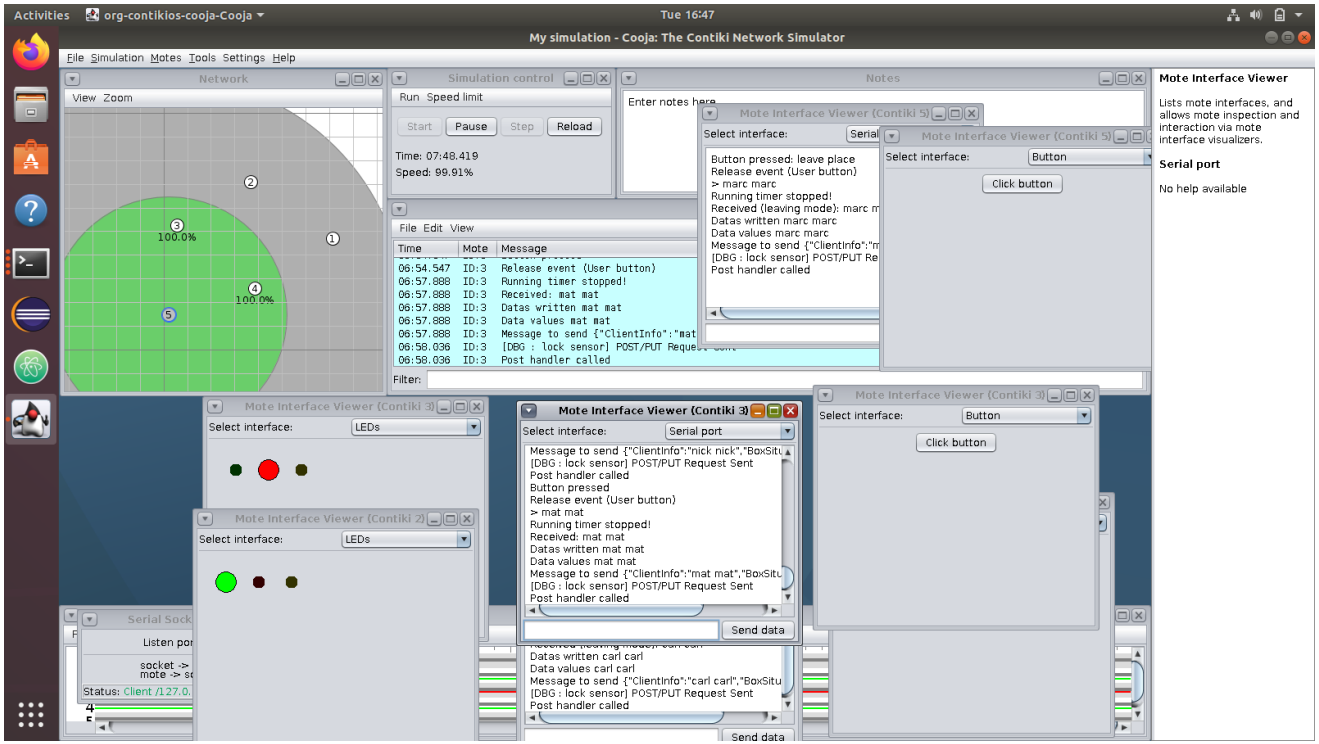

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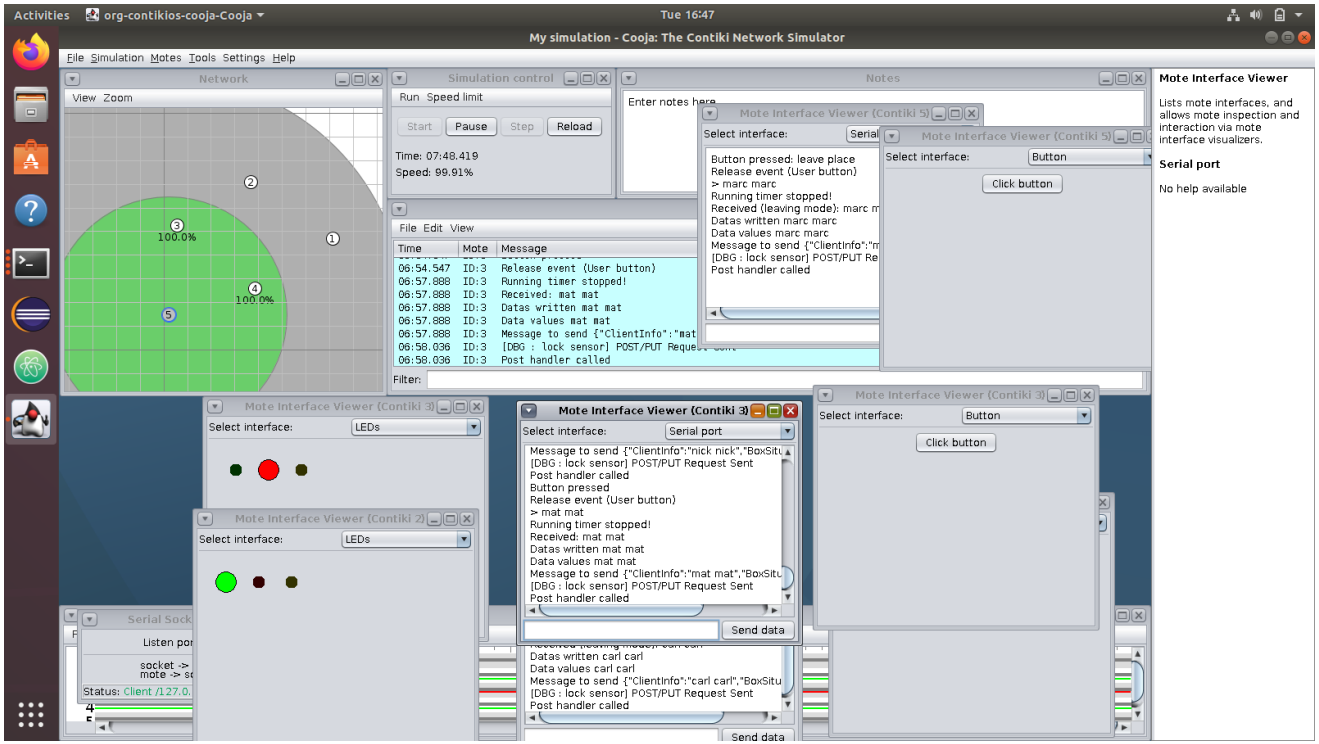

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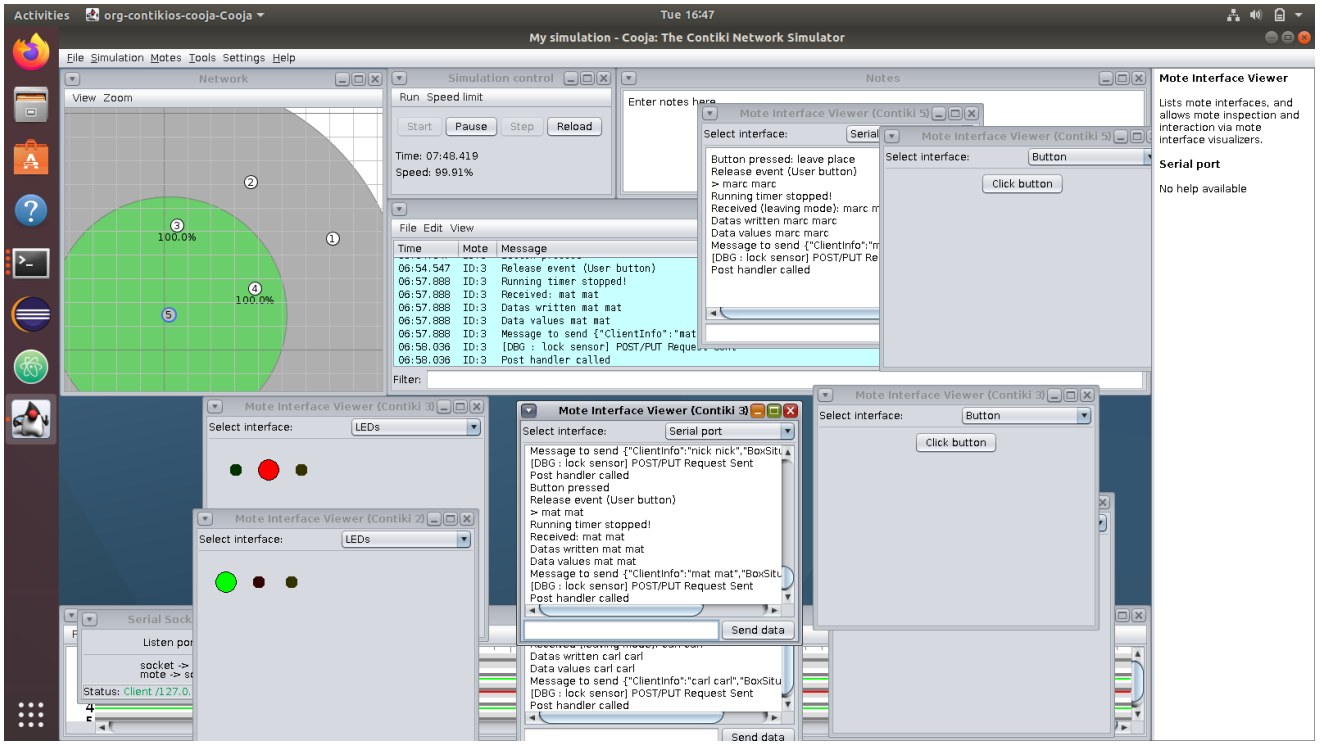

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- In the meantime on the testbed..

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```
user@studente15:~/contiki-ng/Project/sensors/mqtt_sensor$ make TARGET=nrf52840 BOARD=dongle login PORT=/dev/ttyACM15
rlwrap ../../../tools/serial-io/serialdump -b115200 /dev/ttyACM15
connecting to /dev/ttyACM15 [OK]
Connecting!
Application has a MQTT connection
Nothing
Nothing
Nothing
Nothing
Message: {"temp":0,"umidity":0,"weather":0}
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Figure 1: Testbed MQTT node

- After MQTT connection is established, one PROCESS_THREAD checks the connection periodically

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- Another PROCESS_THREAD, every 30 seconds, publish a JSON payload with the environmental information captured

Simulation - Collector

```
osboxes@osboxes:~/contiki-ng/Project/collector$ python3 server_test.py
Initializing server and MQTT client thread
Instantiating!
Mqtt client starting
Connected with result code 0
GET server, received message:

{"NodeType":"Both","MoteResource":"client","NodeID":2}
Instantiating!
GET server, received message:

{"NodeType":"Both","MoteResource":"client","NodeID":4}
Instantiating!
Callback called, resource arrived
{"ClientInfo":"","BoxSituation":"F"}
Credentials are empty: discard message...
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Figure 2: Node registration

- Each coap sensor register through the coap server

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Figure 2: Node registration

```
weatherinfo b'{"temp":11,"umidity":0,"weather":2}'
+------+---------------------+-------------+-----------+-----------+
|  id  |      timestamp      | temperature | umidity   | weather   |
+======+=====================+=============+===========+===========+
|    1 | 2021-06-01 16:40:09 |          30 |        89 | RAINY     |
+------+---------------------+-------------+-----------+-----------+
|    2 | 2021-06-01 16:40:39 |          28 |        65 | RAINY     |
+------+---------------------+-------------+-----------+-----------+
|    3 | 2021-06-01 16:41:09 |           6 |        54 | CLOUDY    |
+------+---------------------+-------------+-----------+-----------+
|    4 | 2021-06-01 16:41:39 |          23 |        51 | CLOUDY    |
+------+---------------------+-------------+-----------+-----------+
|    5 | 2021-06-01 16:42:09 |           9 |         8 | SUNNY     |
+------+---------------------+-------------+-----------+-----------+
|    6 | 2021-06-01 16:42:39 |          25 |        80 | SUNNY     |
+------+---------------------+-------------+-----------+-----------+
|    7 | 2021-06-01 16:43:09 |           0 |        42 | RAINY     |
+------+---------------------+-------------+-----------+-----------+
|    8 | 2021-06-01 16:43:39 |          27 |        42 | SUNNY     |
+------+---------------------+-------------+-----------+-----------+
|    9 | 2021-06-01 16:44:09 |          11 |         0 | RAINY     |
+------+---------------------+-------------+-----------+-----------+
```

```
Callback called, resource arrived
{"ClientInfo":"carl carl","BoxSituation":"B"}
Client credentials are:
['carl', 'carl']
User recognized!
B
<pymysql.connections.Connection object at 0x7f5d98710278>
<pymysql.connections.Connection object at 0x7f5d98710278>
+------+---------------------+--------+------------+
|  id  |      timestamp      | name   | entering   |
+======+=====================+========+============+
|    1 | 2021-06-01 16:40:40 | mat    |          1 |
+------+---------------------+--------+------------+
|    2 | 2021-06-01 16:41:08 | mat    |          0 |
+------+---------------------+--------+------------+
|    3 | 2021-06-01 16:42:06 | carl   |          1 |
+------+---------------------+--------+------------+
|    4 | 2021-06-01 16:42:41 | carl   |          0 |
+------+---------------------+--------+------------+
```

Figure 3: Data log

- Each coap sensor register through the coap server
- Every time an update is published on the MQTT broker or a user acts on the lock sensor, the database is updated and the data log is showed

Implementation choices

- I decided to implement the collector using Python. I exploited the CoAPThon library together with the paho-mqtt. In addition, I used the PyMySQL library to access, insert and query the database, and another module tabulate to show the data log from the database in a nice way
- Regarding the data encoding, I choose JSON, being a lightweight data encoding language
- Very suitable in my case, since the data transmitted is not much and on Python side I have an easy way to manage it
- Only the POST payload from the server to the lock sensors is passed as a POST variable, having only a flag 0/1 meaning unlock/lock of the chain

Reproduce

To reproduce the simulation on remote testbed, login into the remote testbed with 3 different terminals, one of them forwarding the local 1883 port:

- Remember to add `listener 1883 localhost` to *mosquitto.conf* and the `define IEEE802154_CONF_PANID 0x0015` to both router and mqtt sensor

Terminal #1

- `cd contiki-ng/Project/sensors/rpl-border-router`
- `make TARGET=nrf52840 BOARD=dongle border-router.dfu-upload PORT=/dev/ttyACM67`
- `make TARGET=nrf52840 BOARD=dongle connect-router PORT=/dev/ttyACM67`

Terminal #2

- `sudo mosquitto -c /etc/mosquitto/mosquitto.conf`

Terminal #3

- `cd contiki-ng/Project/sensors/mqtt-sensor`
- `make TARGET=nrf52840 BOARD=dongle mqtt-client.dfu-upload PORT=/dev/ttyACM15`
- `make TARGET=nrf52840 BOARD=dongle login PORT=/dev/ttyACM15`