

# SMART WASTE COLLECTION



# WHAT IS THE PROBLEM TO HANDLE?

- The problem is the one of emptying a group of public garbage bins in a smart and planned way.  
Smart means preventing them to be full for a long time or emitting foul smells, and at the same time do not gather the garbage too early.
- This could help also the citizens to throw away the garbage in the best spot possible, which means the closest and the one which appropriate bins are still empty enough.

# WHY IOT IS NEEDED?

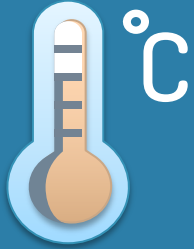
IoT is needed because placing a node on each bin allow us to gather data in a capillar way so that we can serve each bin or group of bins in a targeted manner.

# WHICH ARE THE COMPONENTS AND HOW THEY COMMUNICATE

- There will be a node on each bin.
- Each node will be provided with a LoRa Antenna to communicate with other peers.
- At least one node for autonomous system will have a wifi antenna to connect to the edge and so towards the cloud.

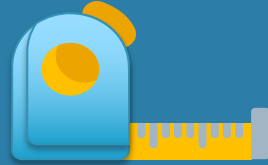
So peers will create chain of message passing to send/receive status, alerts and configuration updates to and from nodes connected to the internet

# WHAT DATA ARE COLLECTED?



## TEMPERATURE

To avoid the insurgence of fire



## FILLING LEVEL

Ultrasound sensors to measure distance from the top of the bin to the garbage



## TIME

To know time passed since last collection and avoid foul smells



## BAD GAS LEVEL

Gas sensors to detect foul smells

# HOW DO WE ARE GOING TO ACT?

- Sending a notification when a bin becomes too full.
- Sending an alarm when a fire or general problem due to temperature may arise.



## WHAT WE ARE GOING TO LEARN?



Each bin will learn how fast it will be filled, so it will adjust the threshold to trigger the alarm to be gathered.

# CONSTRAINTS



## ENERGY

The batteries must last for years



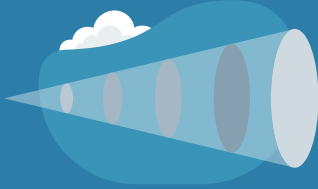
## DISTANCE

Bins have to communicate over hundreds of meters



## LOAD BALANCING

Some nodes have more workload than others



## BANDWIDTH

Limit message size between peers and reduce operations involving the cloud



## CLOCK DRIFT

Synchronization must be enforced to support communication



# EVALUATION METRICS FOR CONSTRAINTS

## ENERGY CONSUMPTION

Monitor with a  
ina219 the  
energy  
consumption  
of different  
nodes

## BANDWITH USAGE

Measure the  
quantity of  
data sent  
through the  
cloud

## PACKET DELIVERY

Ratio of  
delivered  
messages  
between peers

## NUMBER OF FAILURES

Number of  
times that the  
bin becomes  
completely full  
or emits foul  
smells

# WHICH EXTERNAL SERVICES ARE WE GOING TO USE?

- Cloud services to store data, like AWS
- MQTT message broker to send notifications and receive configuration updates



# HOW TO MEASURE EFFECTIVENESS OF ACTIONS

- Average time passed since a bin becomes full and its collection.
- Average remaining space in the bins at time of collection

