

Connected Bus Monitor

For Sustainable Mobility

DIPARTIMENTO DI INGEGNERIA INFORMATICA
AUTOMATICA E GESTIONALE ANTONIO RUBERTI



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CONCEPT

What is sustainable mobility?

The transport sector has the potential to improve the lives and livelihoods of billions of people. However, as well as meeting people's needs today, the sector must be ready to respond to future generations' expectations:

- Shared mobility
- **Public transport**
- **Smart mobility**
- **Access to mobility**
- Walking & cycling
- **Safety**
- **Reducing emissions**

The problem

Improve the service quality of surface public transport solutions providing trustworthy information about the availability of surface public transport options and the air quality conditions onboard.

- Reducing the waste of time
- Improving the travel conditions
- Providing trustworthy information to help making informed mobility choices
- Guaranteeing safety and salubrity
- Reducing congestion and occupation of parking spaces

Project Goals

Provide a cost-effective solution to improve public transport by meeting the needs of potential users

- Affordability
- Reliability
- Safety and Salubrity
- Sustainability

Proposed Solution

Connected Bus Monitor: a service aimed at providing (near) real time estimates of waiting times/proximity and indoor air quality of the surface public transport units.

Aims to provide incentives to use public transport as a reliable and affordable means of sustainable mobility oriented at reducing emissions, congestion and occupation of parking spaces in urban areas.

Proposed Solution

How?

- Monitor transport unit position/location
 - GPS, acceleration
- Monitor air quality onboard
 - Temperature, humidity, CO2 levels

Why IoT?

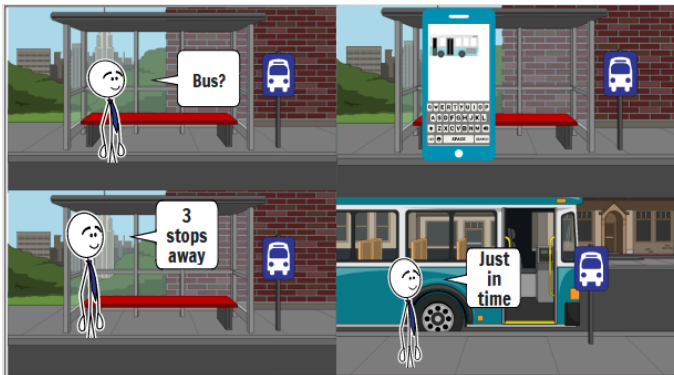
- Collect and aggregate data from transport units (things)
- Scalability
- Feasibility (financial, technical)

Actors and Use Cases

Who?

- Public transport users
Private sector employee, Student
- Public transport drivers

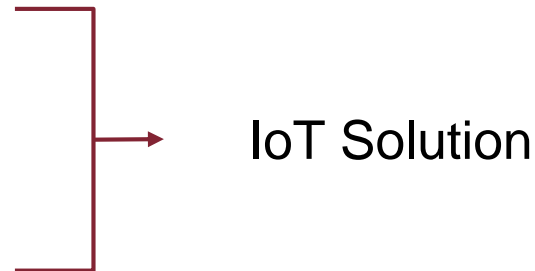
Use Case Scenarios



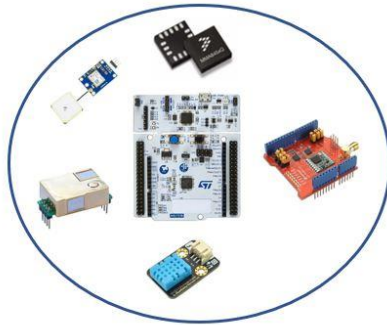
TECHNOLOGY

Goals and why we need IoT

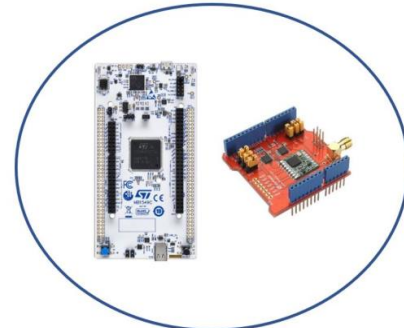
- Before to take a bus we want to have all the information to choose the best one
 - The nearest one
 - The one with best air quality (claustrophobia)
 - A near bus with an acceptable air quality
- We want all these information in a single place
 - Web page
 - Smartphone App
- Resuming:
 - Connecting buses
 - Collecting data
 - Elaborate data
 - Provide a service



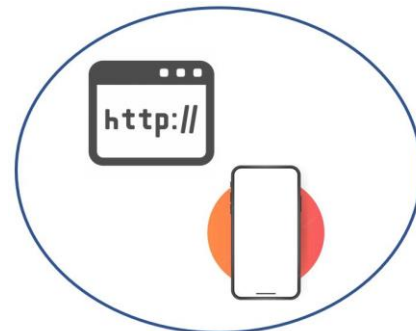
Main Components



BUS MONITOR



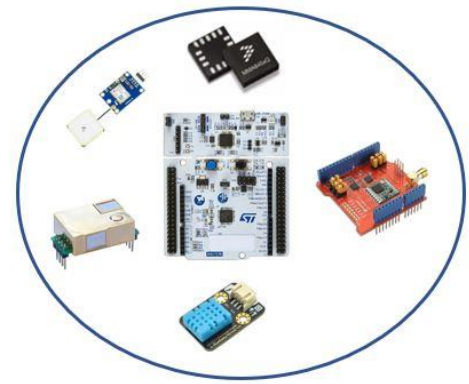
GATEWAY



FRONT-END

Bus Monitor

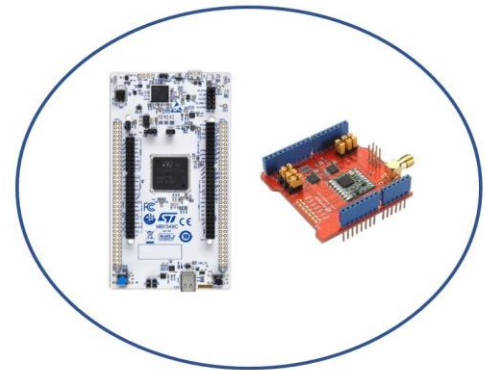
- Placed inside the bus, the bus monitor collects data about the position and the air parameters inside the bus. Then it transmits the collected data to a gateway.
- Hardware:
 - STM32 Nucleo-F401RE board
 - GPS
 - Accelerometer sensor
 - Humidity & Temperature sensor
 - CO2 Sensor
 - LoRa Shield



BUS MONITOR

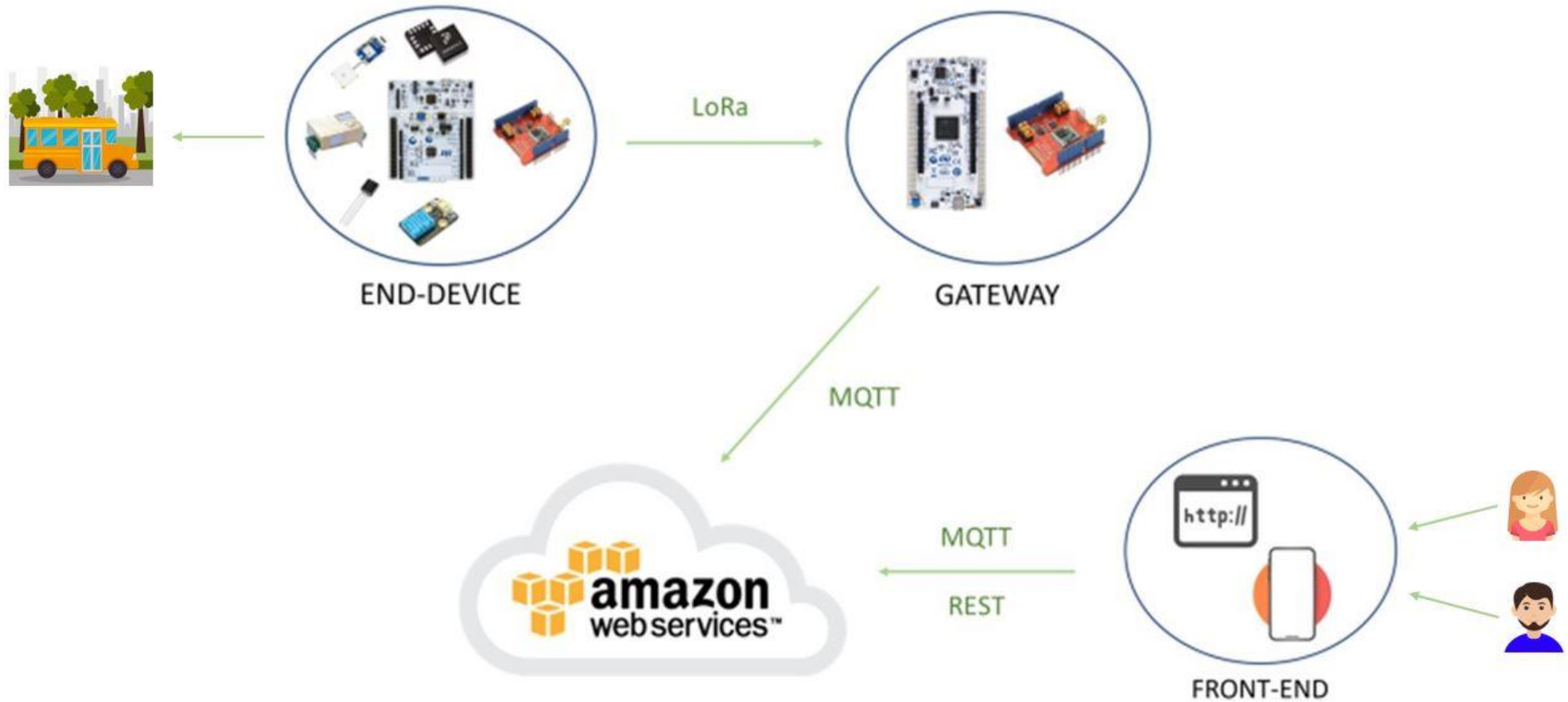
Gateway

- Receives data from Bus Monitors and stores them into a database stored in the cloud
- Its goal is to update the database as soon as it receives new data
- Hardware:
 - STM32 Nucleo-F446ZE board
 - LoRa Shield



GATEWAY

Overall Architecture



EVALUATION

Evaluation and Performance

- Hardware:
 - Cost
 - Precision
 - Latency
 - Reactiveness
 - Low Power Consumption
- Network Technologies:
 - Long Range connection
 - Network Reliability:
 - Low number of loss packets
 - Scalability
 - Low Power consumption
 - LoRa constraints
- Front-End:
 - User experience

Evaluation and Performance

- Impact on the society
 - Reduce number of private vehicles
 - City Traffic
 - Pollution in the city
 - Changes in habitudes