

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 from every mode of transport

Project contribution to Sustainable Mobility

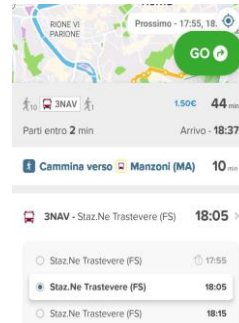
The main goal of the project is to improve the user experience by

- Reducing the waste of time
- Improving the travel conditions
- Fournishing correct correct informations through near real-time data
- Guaranty safety (Health point of view)

Project Goals

1. Near Real Time city bus tracking

- We want to design a system that transmits the position of the bus in near real-time way through GPS data.



One hour
later



- The user can access the true position of the bus at every moment
- Reducing the waste of time

Project Goals

2. Monitor the air quality inside the buses

- The bus monitor will monitor the air quality, in term of level of CO₂, inside the bus



Goal

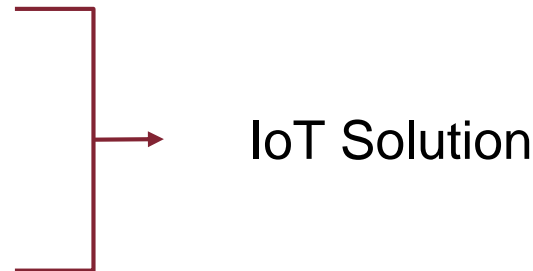


- The quality of the air is estimate combining CO₂ level, temperature and humidity values
- The user can know the condition of the air inside the bus before to take it and choose the best one according to its needed

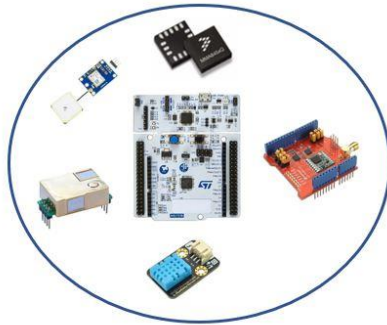
TECHNOLOGY

Goals and why we need IoT

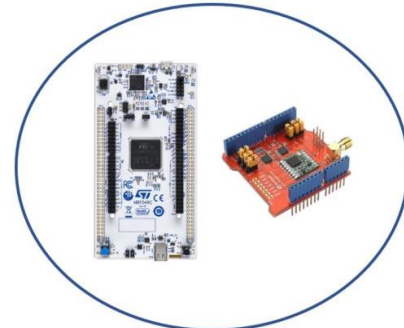
- Before to take a bus we want to have all the information to choose the best one
 - The nearest one
 - The one with best air quality (claustrophobia)
 - A near bus with an acceptable air quality
- We want all these information in a single place
 - Web page
 - Smartphone App
- Resuming:
 - Connecting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



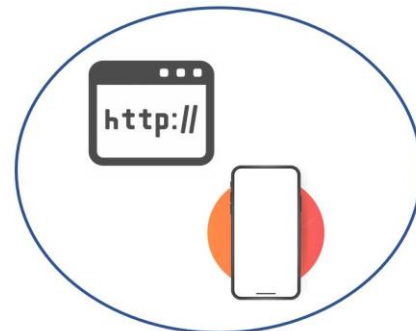
Main Components



BUS MONITOR



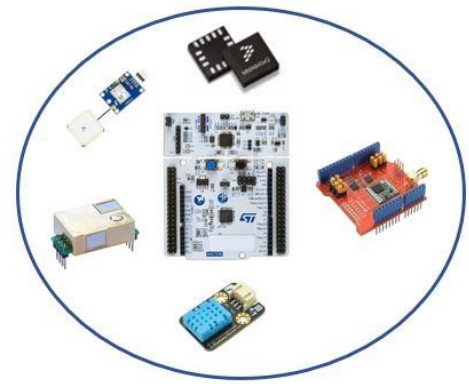
GATEWAY



FRONT-END

Bus Monitor

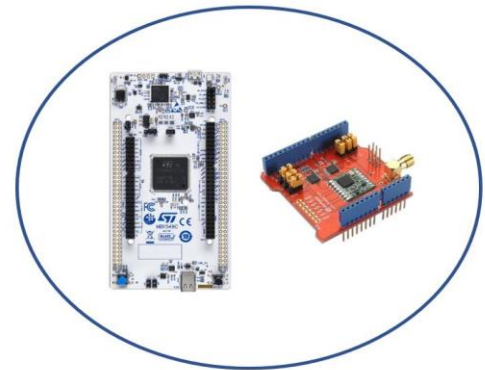
- Placed inside the bus, the bus monitor collects data about the position and the air parameters inside the bus. Then it transmits the collected data to a gateway.
- Hardware:
 - STM32 Nucleo-F401RE board
 - GPS
 - Accelerometer sensor
 - Humidity & Temperature sensor
 - CO2 Sensor
 - LoRa Shield



BUS MONITOR

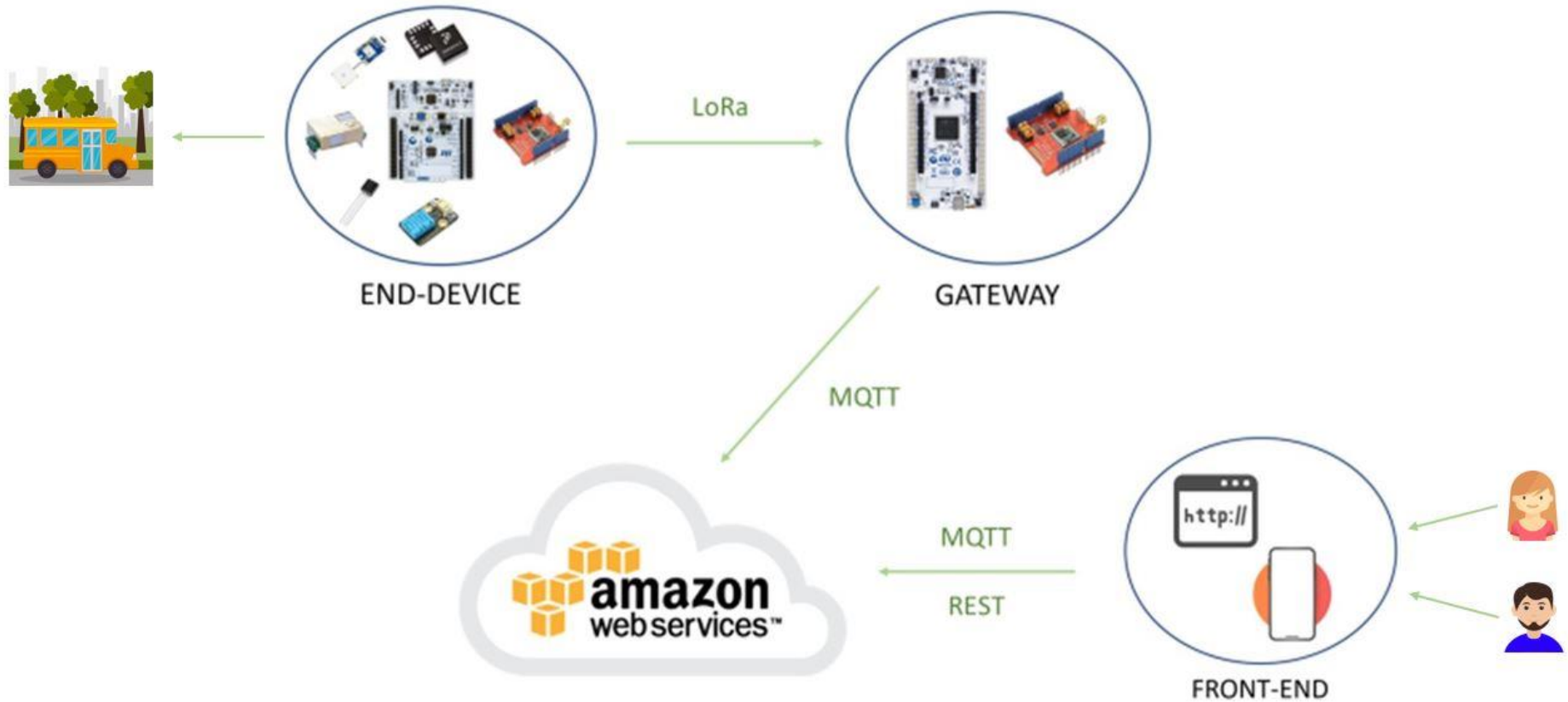
Gateway

- 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