

Home Net System:

Design and implementation of a home automation system for energy consumption control



SAPIENZA
UNIVERSITÀ DI ROMA

Candidate:

Gioele Migno 1795826

Thesis Advisor:

Prof. Alessandro Di Giorgio

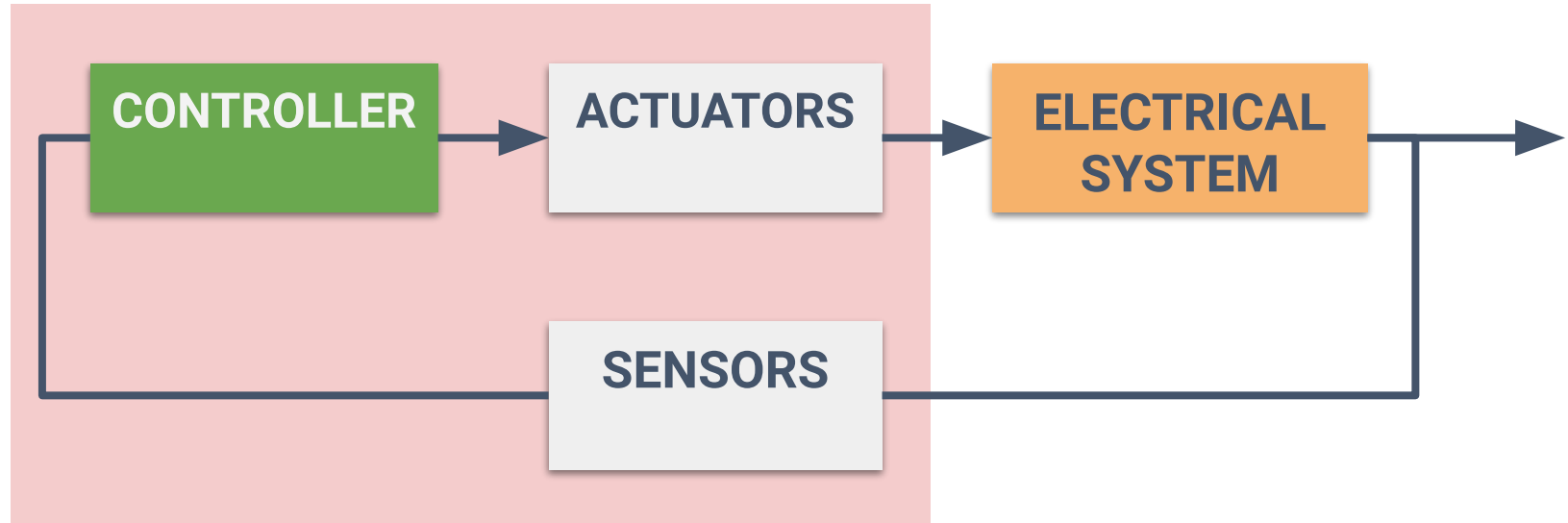
Co-Advisor:

Prof. Vincenzo Suraci

10/13/2020

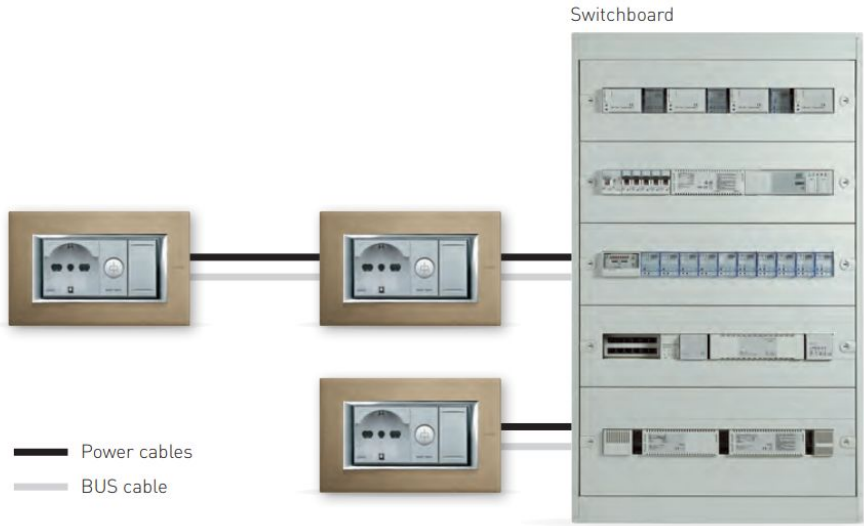
Introduction

Load Management



Domotic System

Commercial Solutions

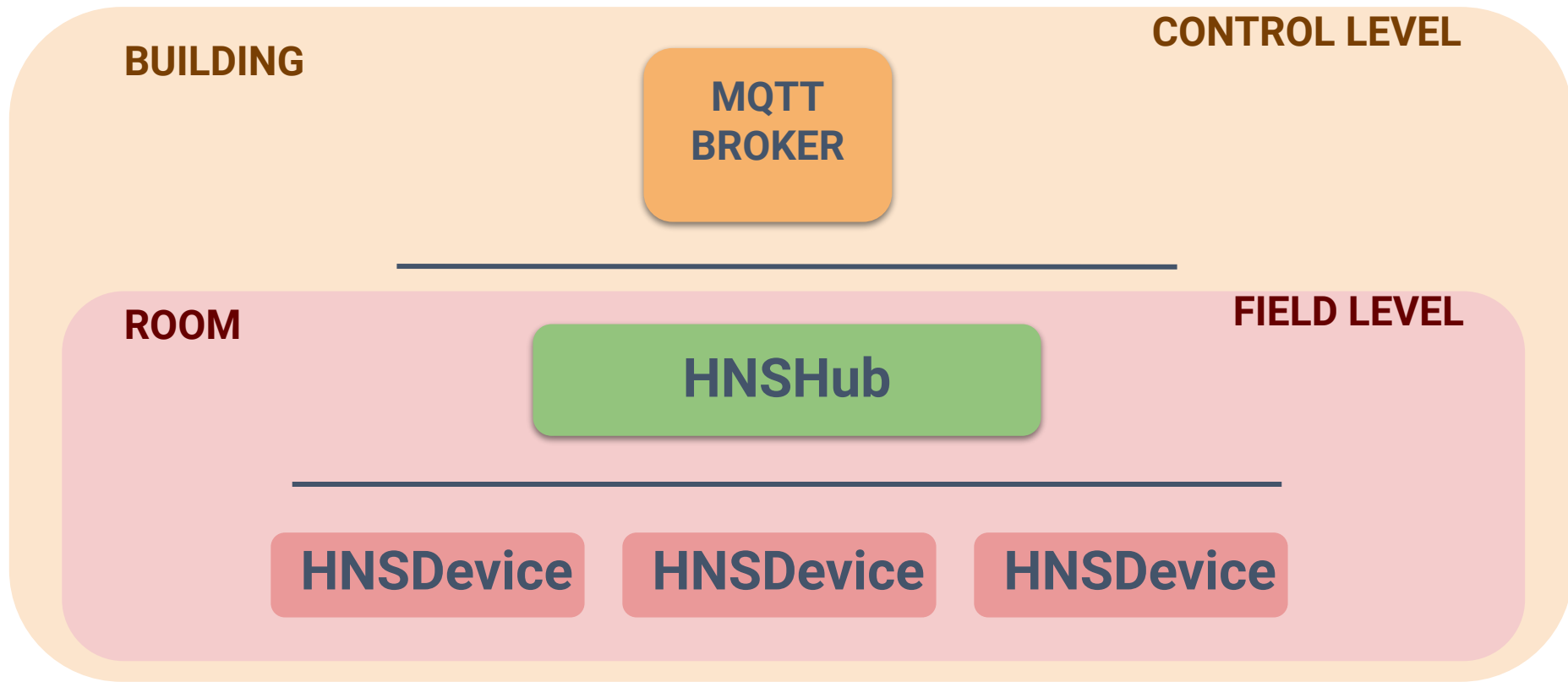


INDUSTRIAL ORIENTED



DEVICES PLUG-AND-PLAY

Hierarchical Structure



Network Architecture

MQTT Broker

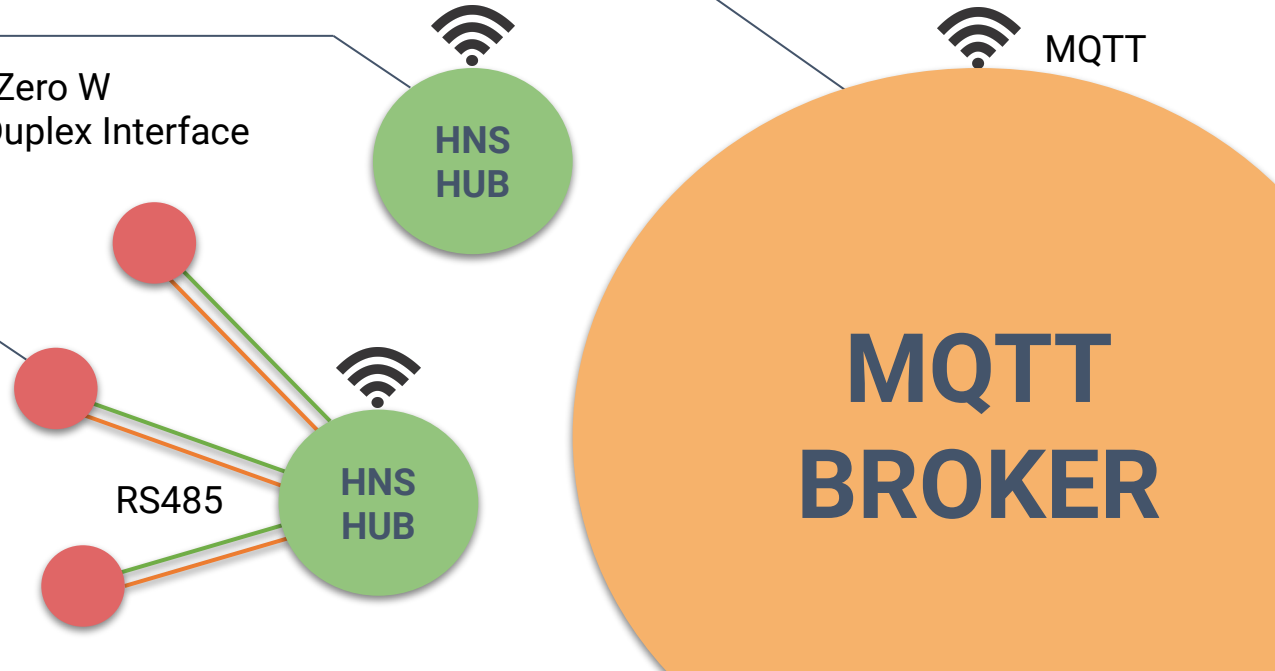
- RaspberryPi

HNSHub

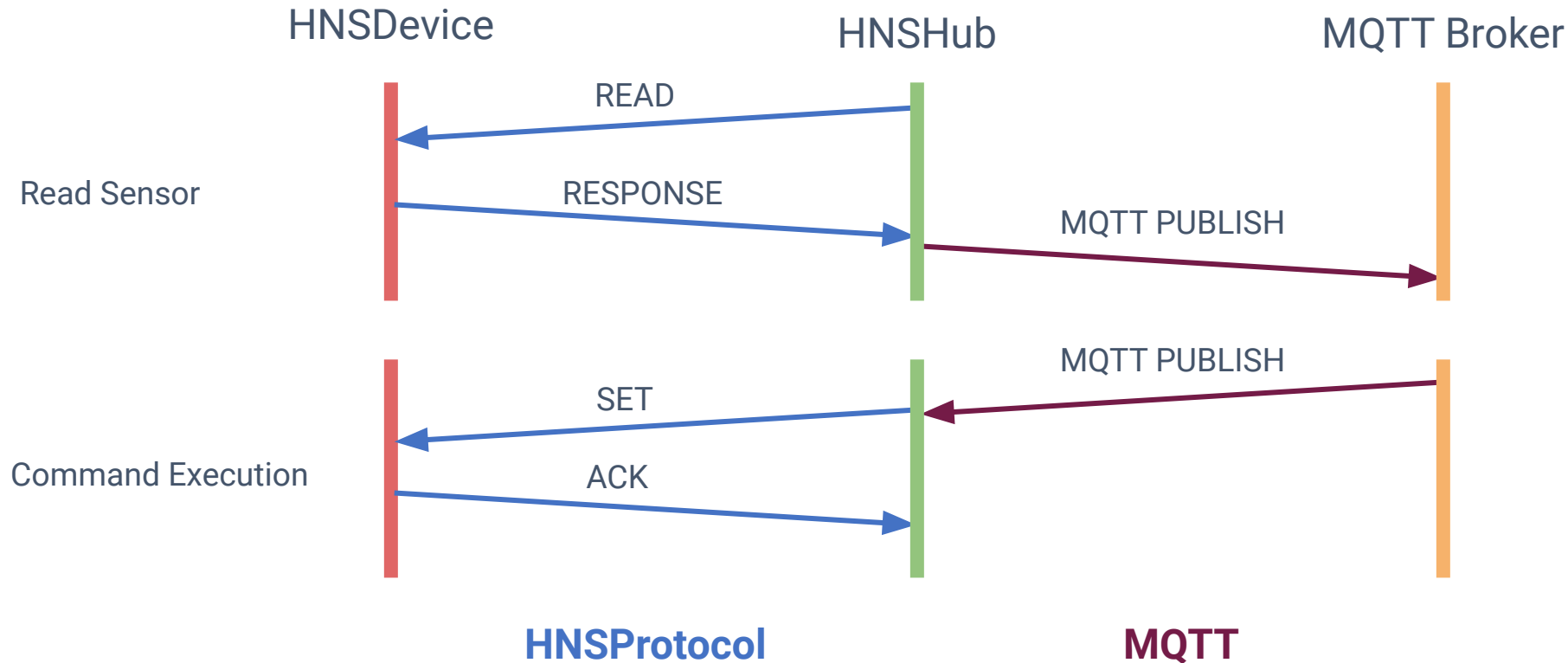
- RaspberryPi Zero W
- RS485 Half Duplex Interface

HNSDevice

- Arduino Pro Mini 16MHz 5V
- RS485 Half Duplex Interface
- Sensor and Actuator



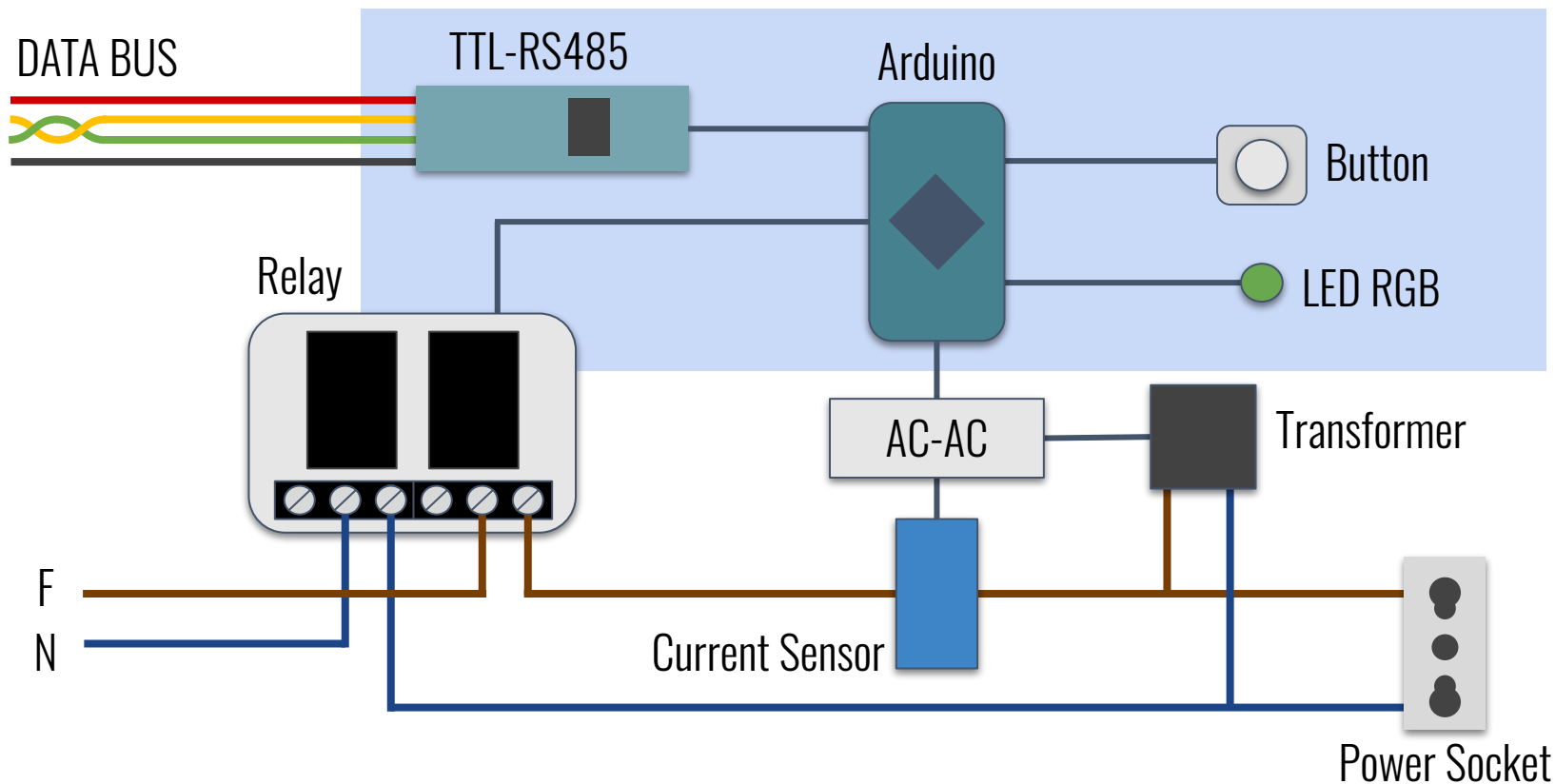
Communication Example



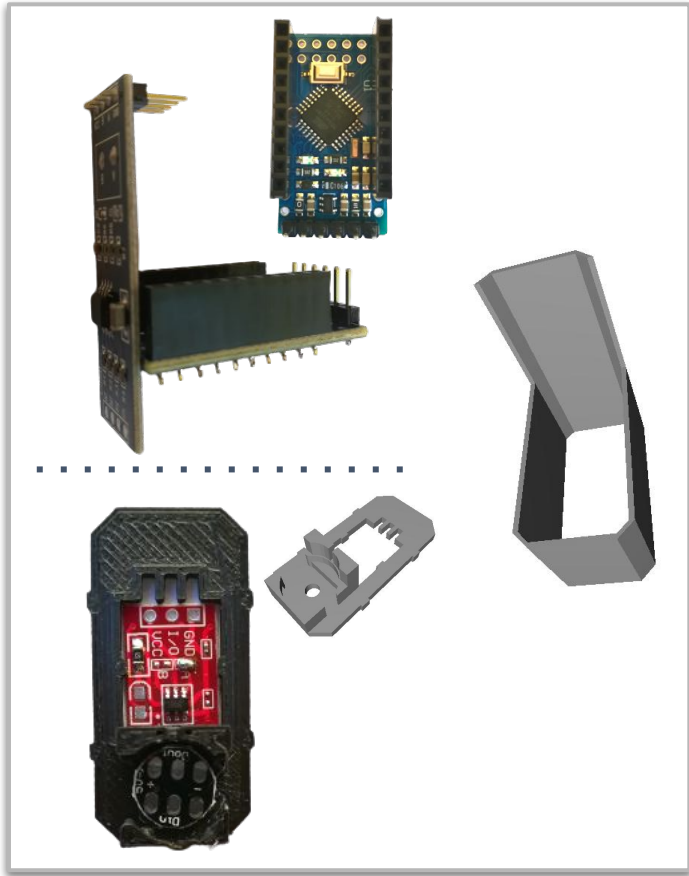
Proof of Concept

Hardware setup

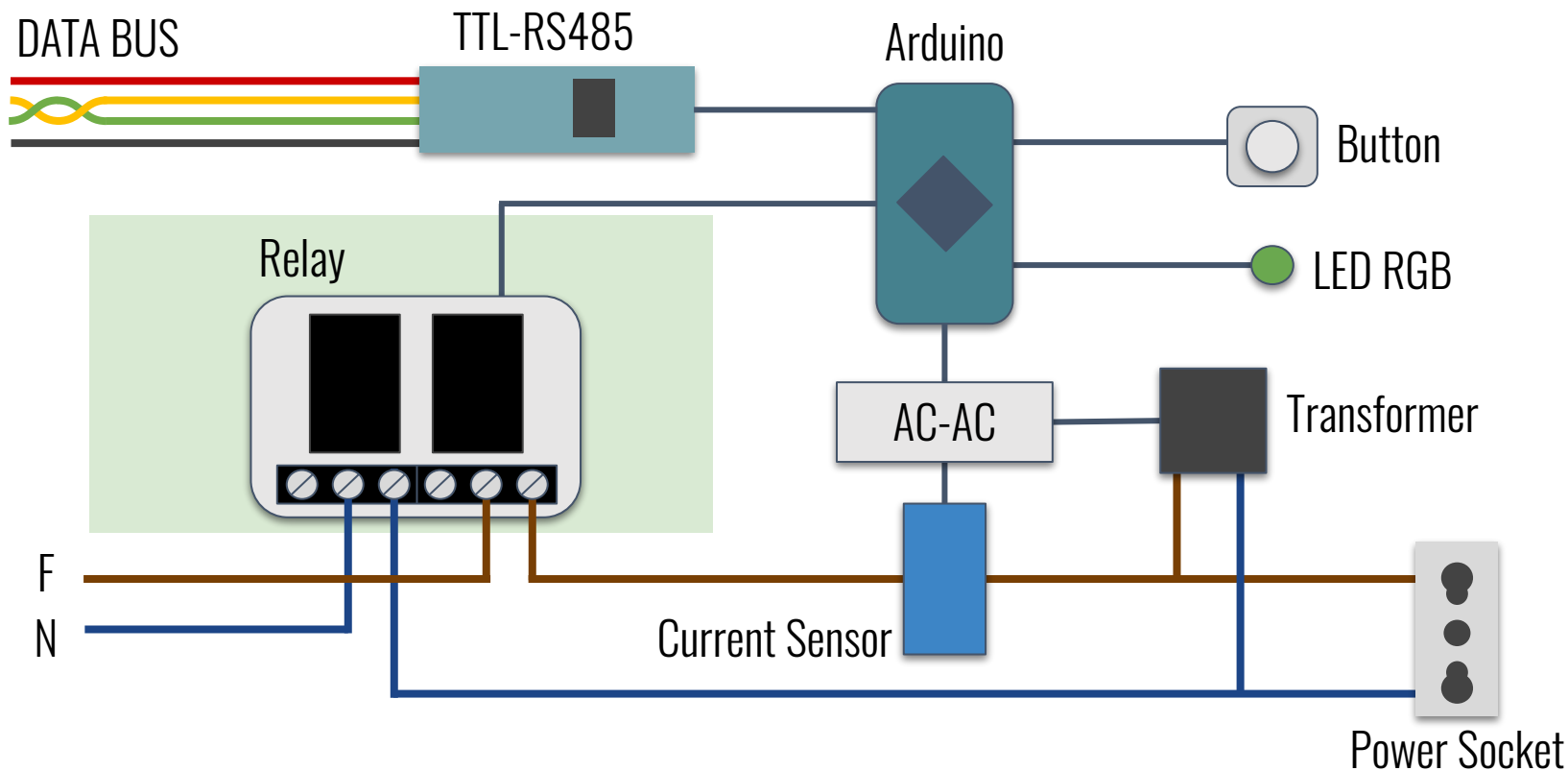
HNSDevice - HNSSocket (Smart Socket)



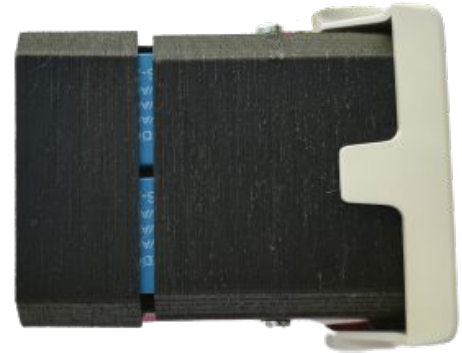
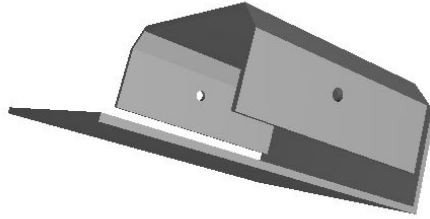
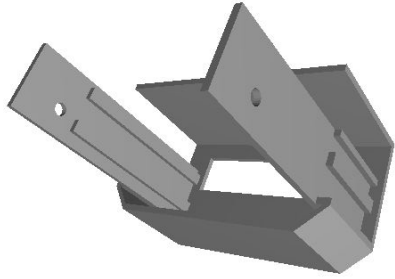
HNSocket: Installation in a false pole



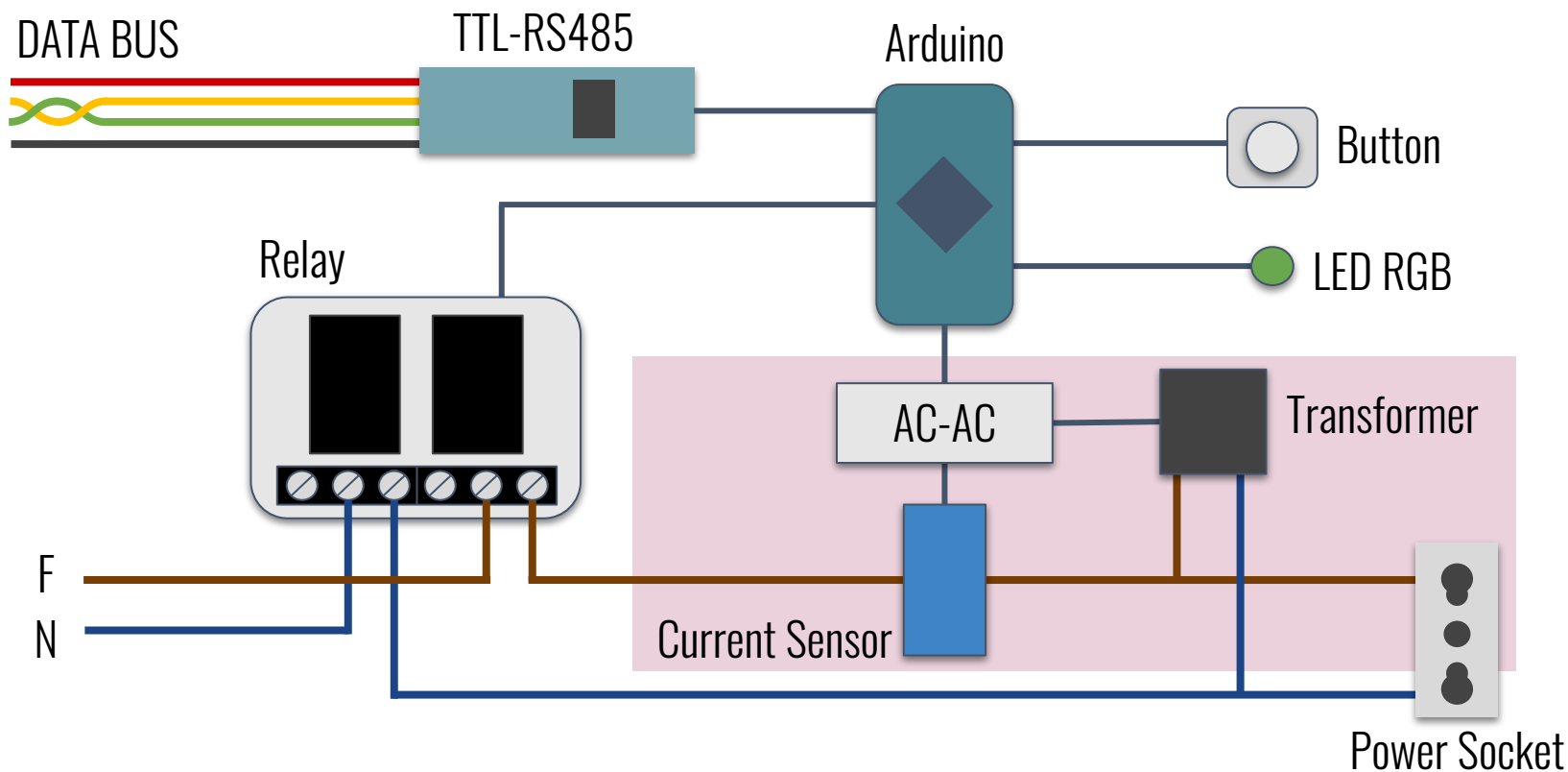
HNSDevice - HNSSocket (Smart Socket)



HNSocket: Relay

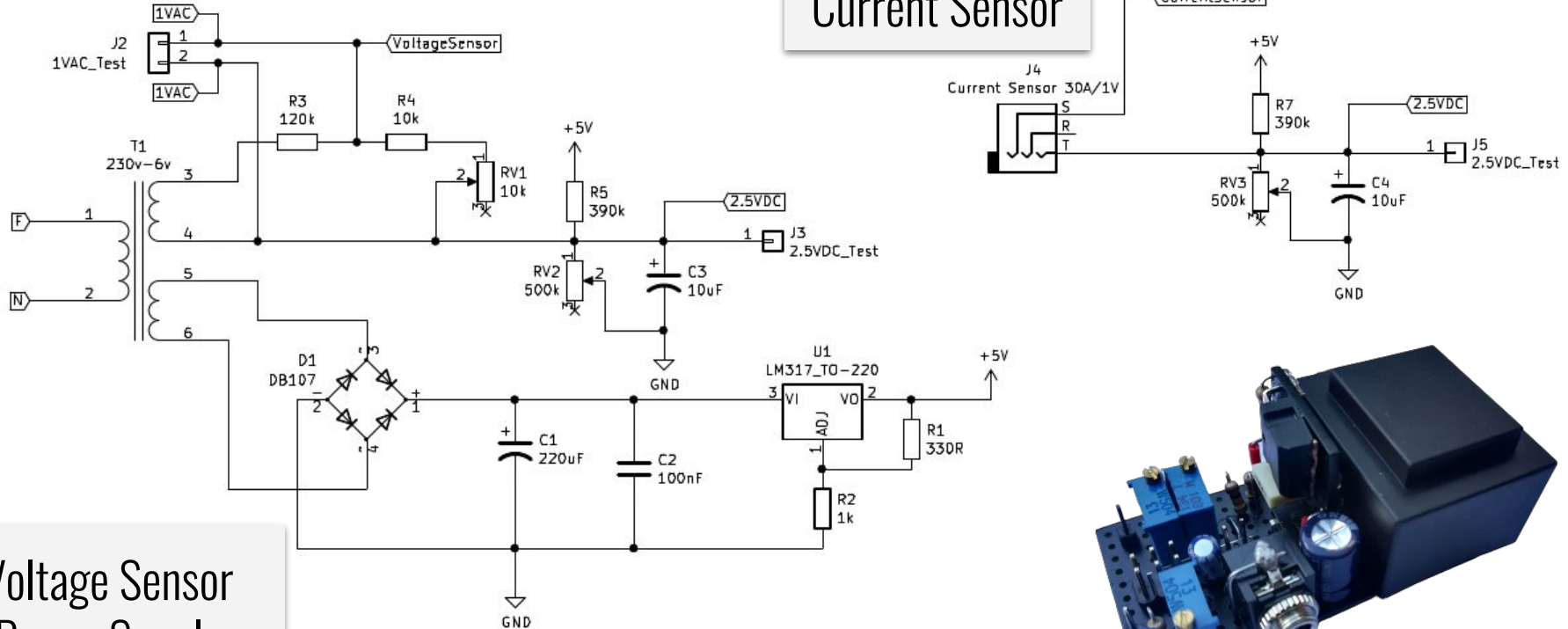


HNSDevice - HNSSocket (Smart Socket)



HNSocket: Circuit Schematic and Realization

Current Sensor



Voltage Sensor Power Supply



HNSocket: Choice number of semi-waves

HNSocket measures real power consumed by load using EmonLib from Open Energy Monitor. It allows us to choice the number of semi-waves of voltage and current to sample.

SEMI-WAVES	READ TIME	VOLTAGE ERROR	ERR. MULT.	CURRENT ERROR	ERR. MULT.
20	200 ms	0.728 %	± 0.8 %	1.341 %	± 2.5 %
14	140 ms	0.924 %		1.697 %	
12	120 ms	0.701 %		1.051 %	
10	100 ms	0.811 %		1.109 %	
08	80 ms	0.819 %		1.128 %	

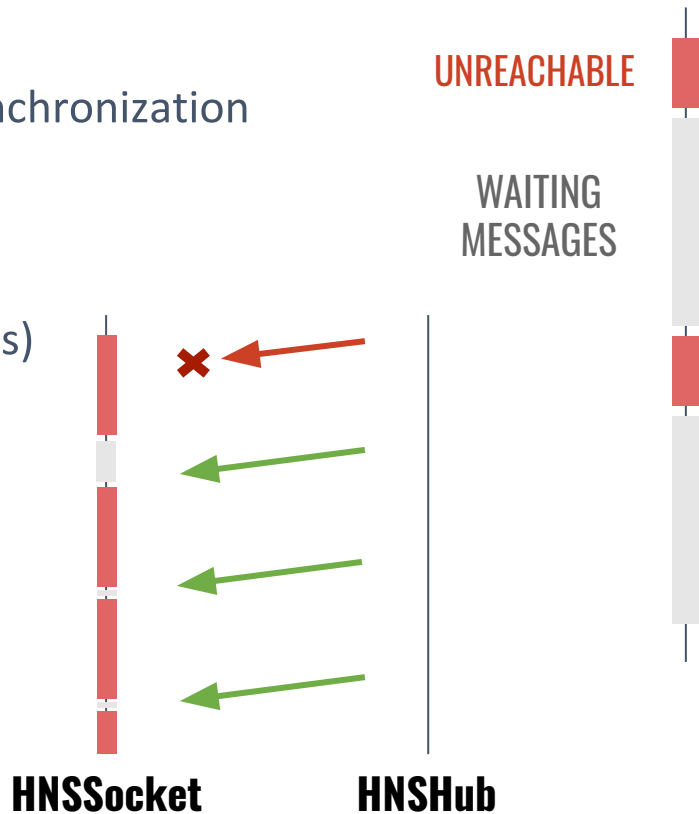
HNSocket: Communication Issue

HNSocket measures real power consumed by load.

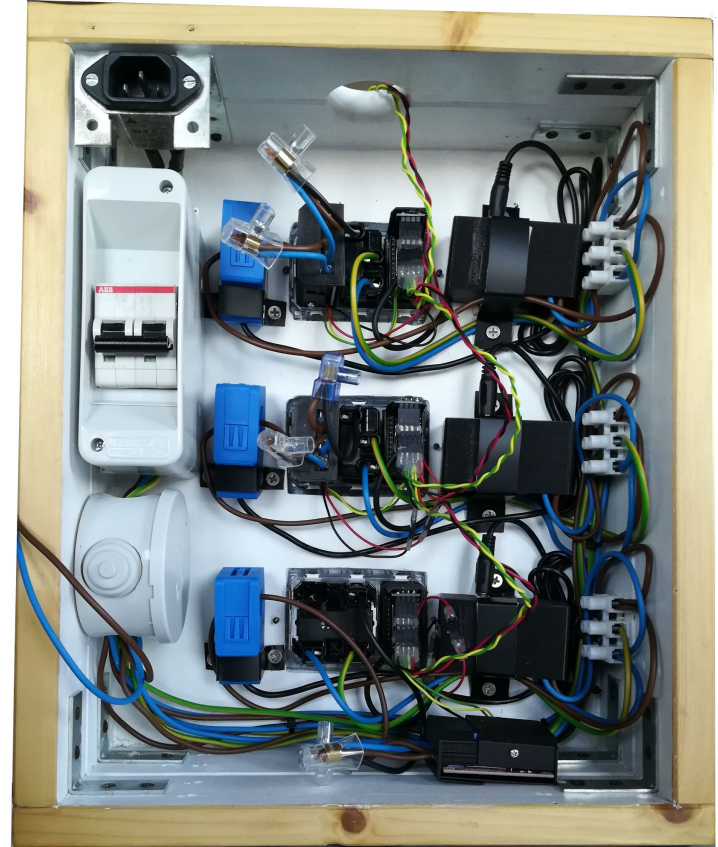
During measurement (~120ms), it is unreachable, so synchronization between HNSocket and HNSHub is required.

How to sync:

- HNSHub sends message with specific period (150ms)
- HNSocket waits until message is received



Proof of Concept



GUI

Example: Smart Socket

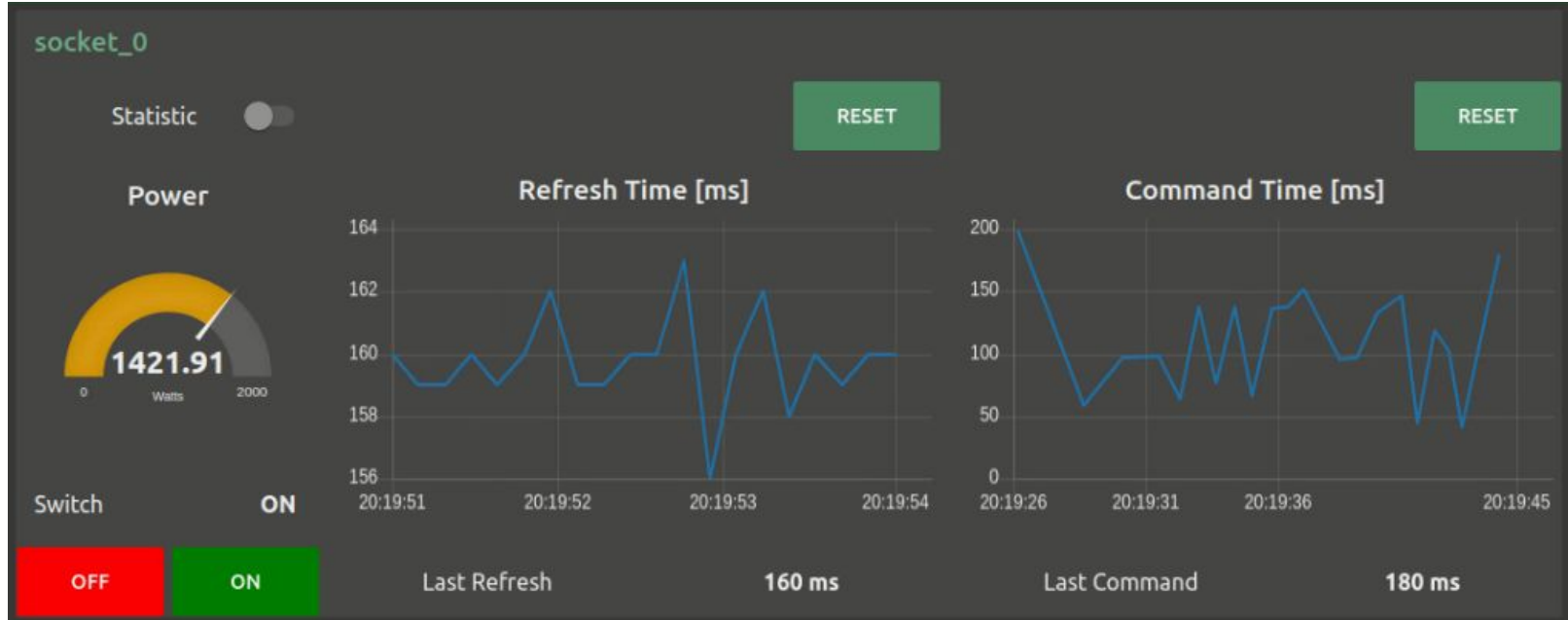
NodeRed Dashboard

SOCKET

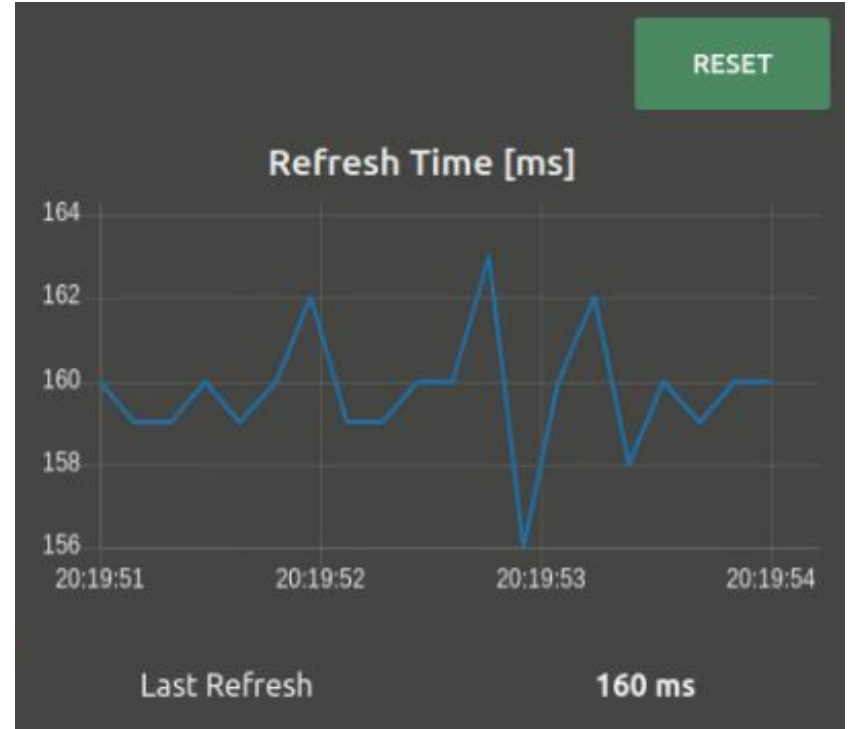
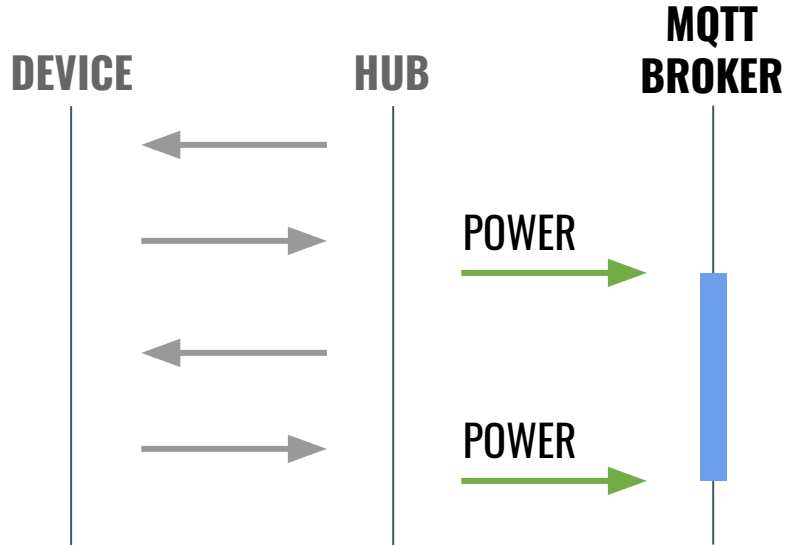
STATISTICAL INFORMATION

REAL POWER

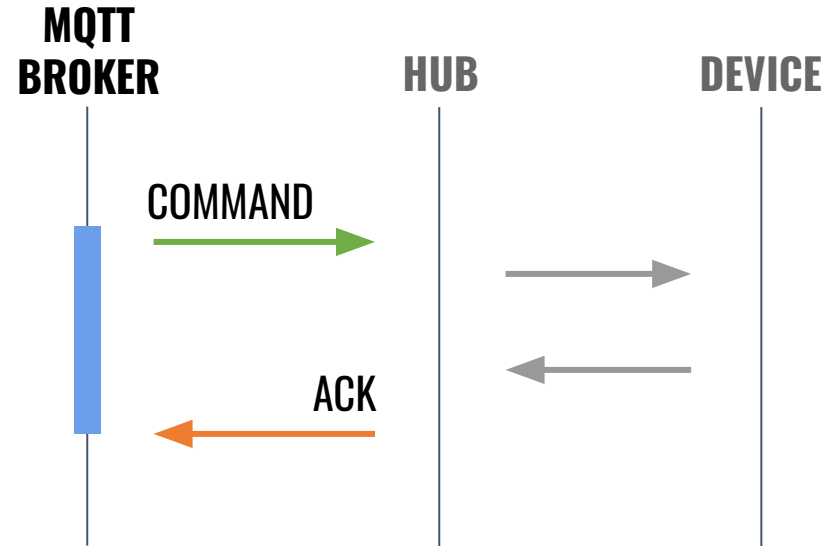
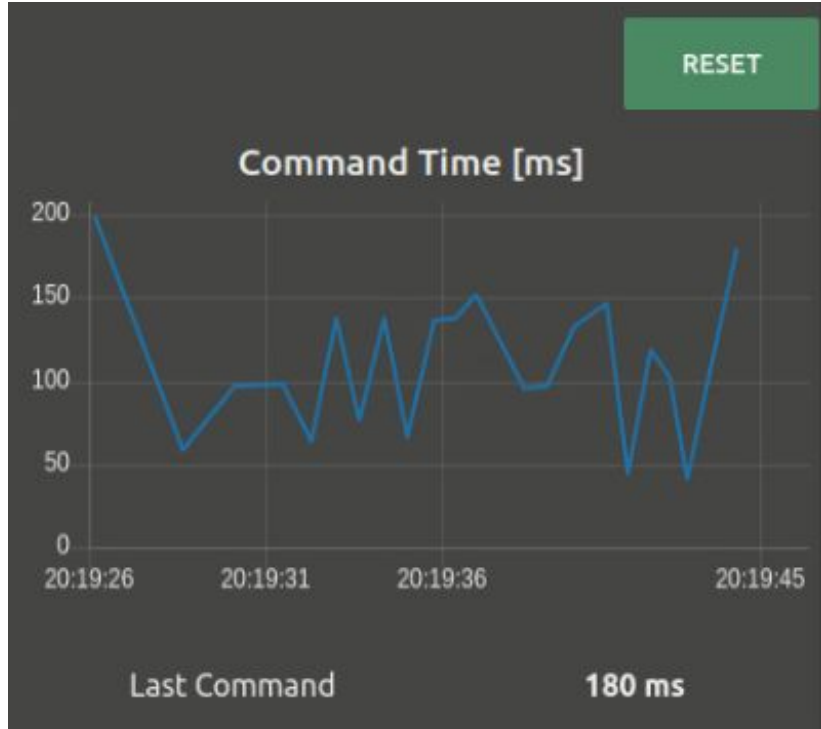
SWITCH COMMAND



NodeRed Dashboard: Refresh Time



NodeRed Dashboard: Command Time



Thanks for the attention
