Hardware for management and diagnostics

Rafał Kotas

About me

Rafał KOTAS

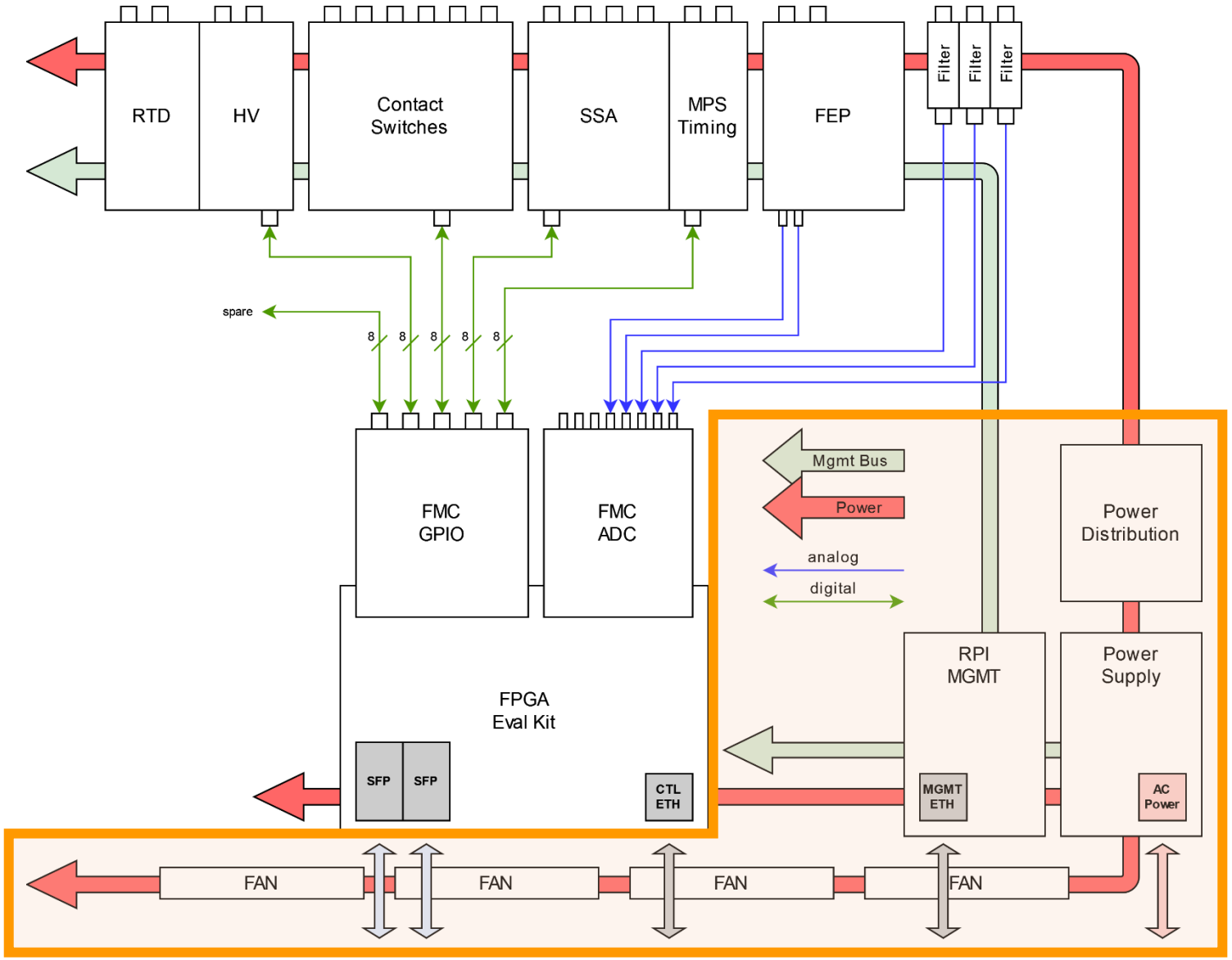
Ph.D. in Electronics

- Role
  - Hardware and software for management and diagnostics module
- Relevant Experience:
  - "Personalized Protective Thermally Active clothiNg", The National Centre for Research and Development project – coordinator
  - "Innovative system for evaluation and rehabilitation of human imbalance", The National Centre for Research and Development project – contractor (control and data acquisition system developer)
  - "The use of the latest generation of BNDCC and DDCC composites for cutting tool", The National Centre for Research and Development project – contractor (control and data acquisition systems developer for pulse plasma sintering technique)
  - „Automated multiparameter system for assessment of the patient's general condition with comprehensive analysis of the respiratory and circulatory functions", The National Science Centre project – contractor (medical data analysis)
  - "Sudden Cardiac Death risk stratification based on functional assessment of autonomic nervous system with the use of Holter methods",The National Centre for Research and Development project – contractor (medical data analysis)
  - "The ARUZ Analyzer of Real Complex Systems" - Technopark Łódź, Polish Agency for Enterprise Development 2015 – contractor (PLC control system developer)
  - "Online support system for the identification and treatment of speech defects in children of preschool age" - The National Centre for Research and Development - Social Innovations Program 2015-2016 – contractor (speech recognition system developer)
  - "Natural Language Processing for PSA navigation system" – PSA (Peugeot-Citroen), Cooperation in the area of personalized car, 2015-2016 – contractor (software developer)

Agenda

- The main requirements,
- The PoC version specification and scope,
- The functionality and design details,
- Implementation,
- Test results discussion,
- Full scale design plans,
- Summary

The main requirements



The main requirements

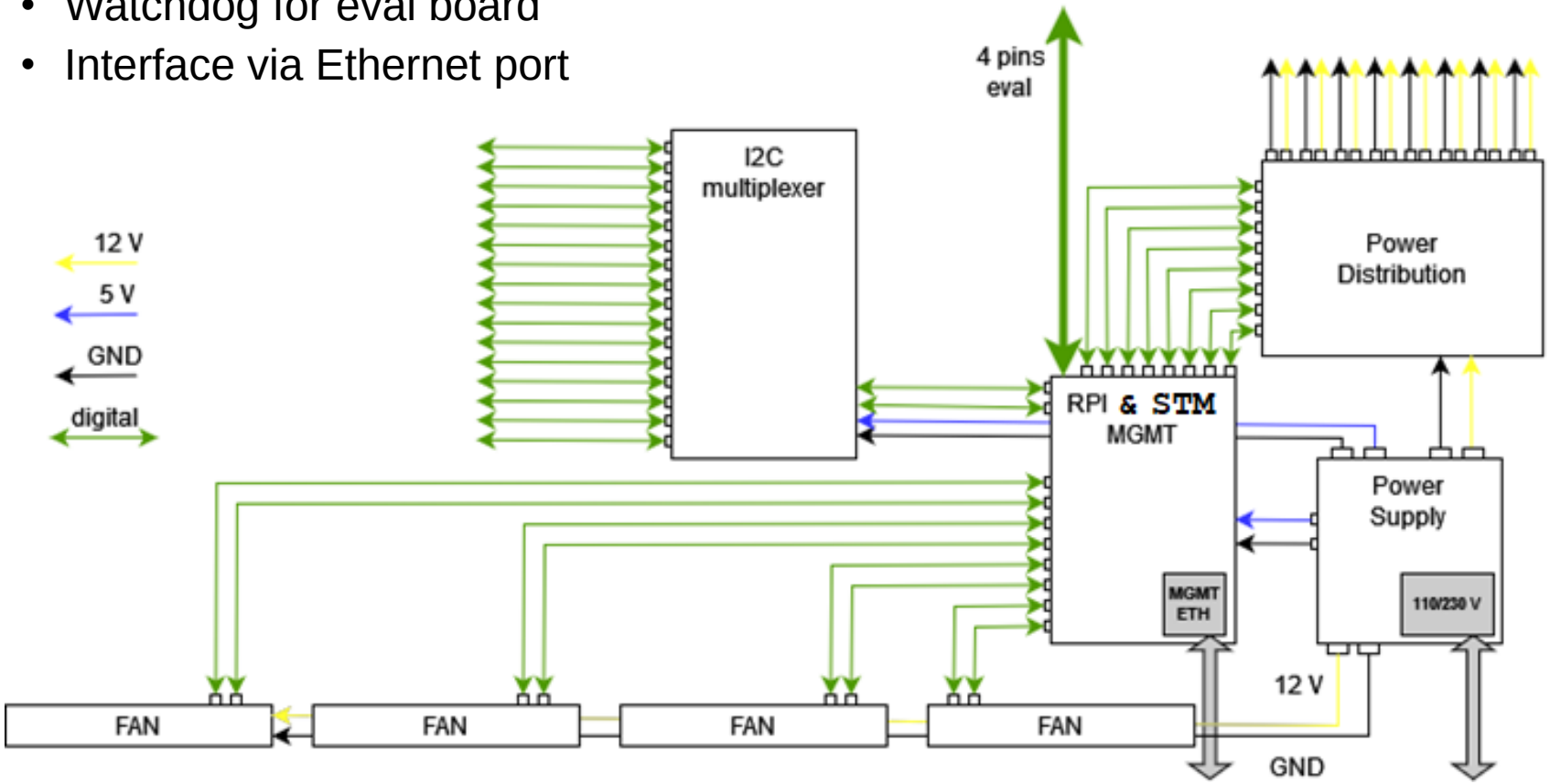
- Main entry point to the management and diagnostics of the entire system:
  - management (control of individual power supplies) of all conditioning boards
  - maintaining environmental conditions (control of fan speed based on temperature and humidity readings from all boards in the system)
  - diagnostics of conditioning boards (reading of voltages and currents)
  - watchdog for FPGA eval board
- Two independent interfaces to system management and diagnostics (EPICS and Node-RED)

The PoC version specification and scope

- Operating system on the management system consistent with eval board – Ubuntu 22.04.1 LTS
- Chosen platform – Raspberry Pi 4
- As GPIO extension STM32
- Limited number of conditioning boards to four (one of each kind) + FPGA eval board
- ITX power supply providing 3.3 V, 5 V and 12 V separately
- Power supply transferred via relays

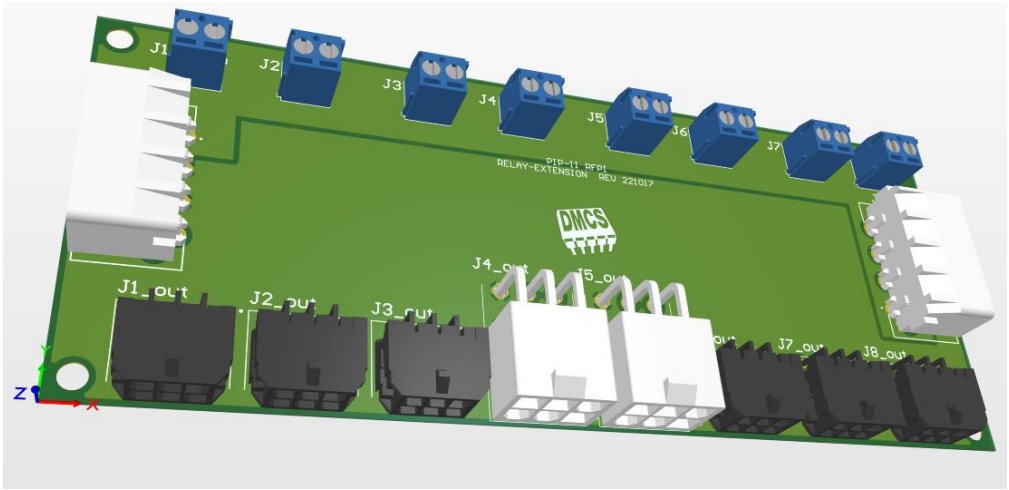
The functionality and design details

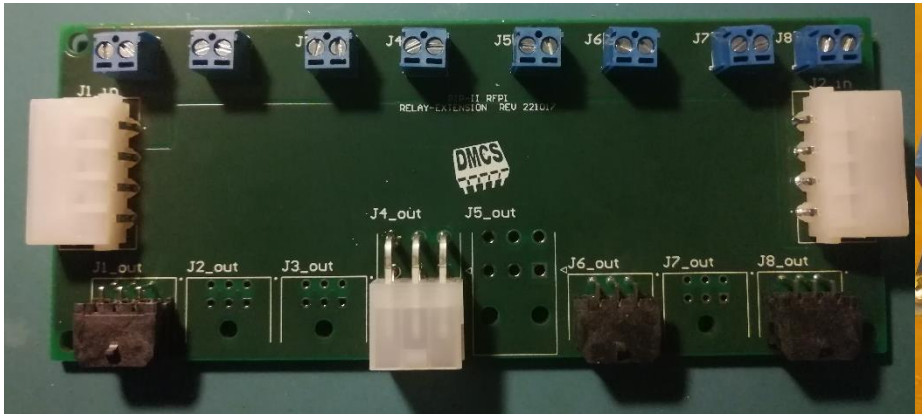
- The system provides:
  - Control of power supply via relays for all conditioning boards individually
  - Diagnostic of temperatures, currents and voltages via I2C interface
  - Control of speed fan
  - Watchdog for eval board
  - Interface via Ethernet port



Implementation

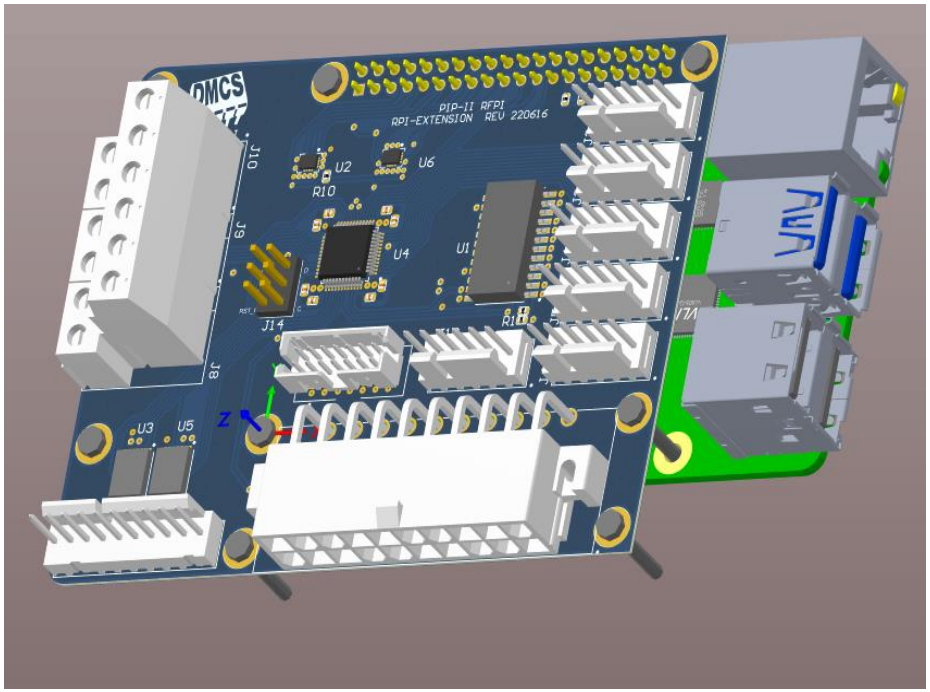
- Power distribution board connected to relays board

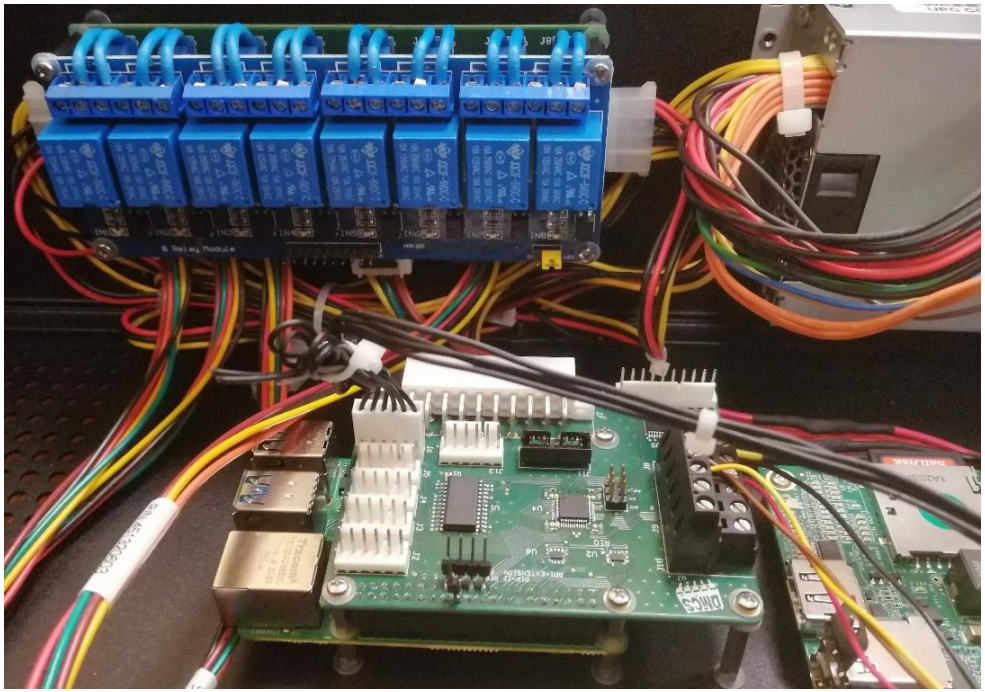




Implementation

- Management board designed as Raspberry Pi 4 extension board





Implementation

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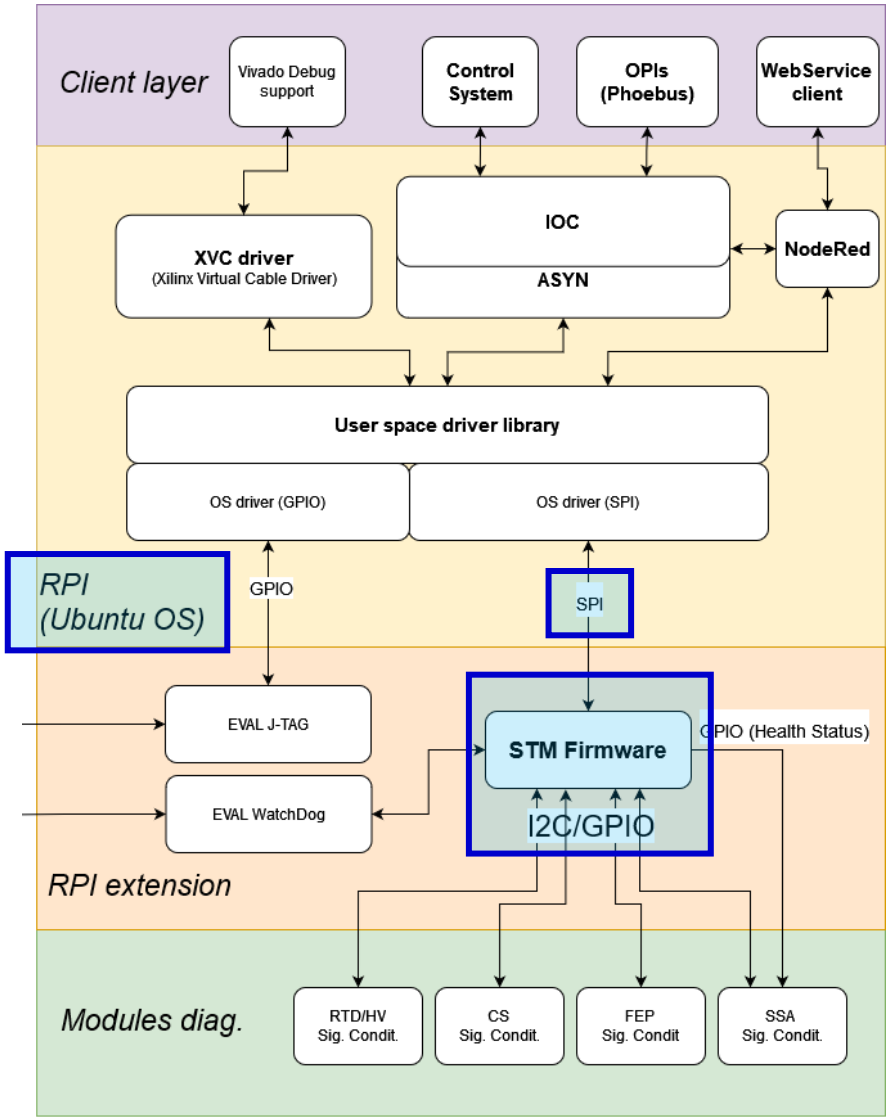


Implementation

- Management board interfaces:
  - five 6-pin connectors for conditioning boards

3.3 V	I2C_SDA	I2C_SCL	GPIO (present)	GPIO (configurable)	GND

  - one 10-pin connector for relays extension board

GND	GPIO (relay_0)	GPIO (relay_1)	GPIO (relay_2)	GPIO (relay_3)	GPIO (relay_4)	GPIO (relay_5)	GPIO (relay_6)	GPIO (relay_7)	5 V

  - one 6-pin connector for fans control

PWM	GND	SENSOR_2	SENSOR_3	PWM	GND
12 V	GND	SENSRO_0	SENSOR_1	12 V	GND

  - one 6-pin connector for watchdog for FPGA eval board

GPIO_0	GPIO_1	GPIO_2	GPIO_3	V_ref	GND

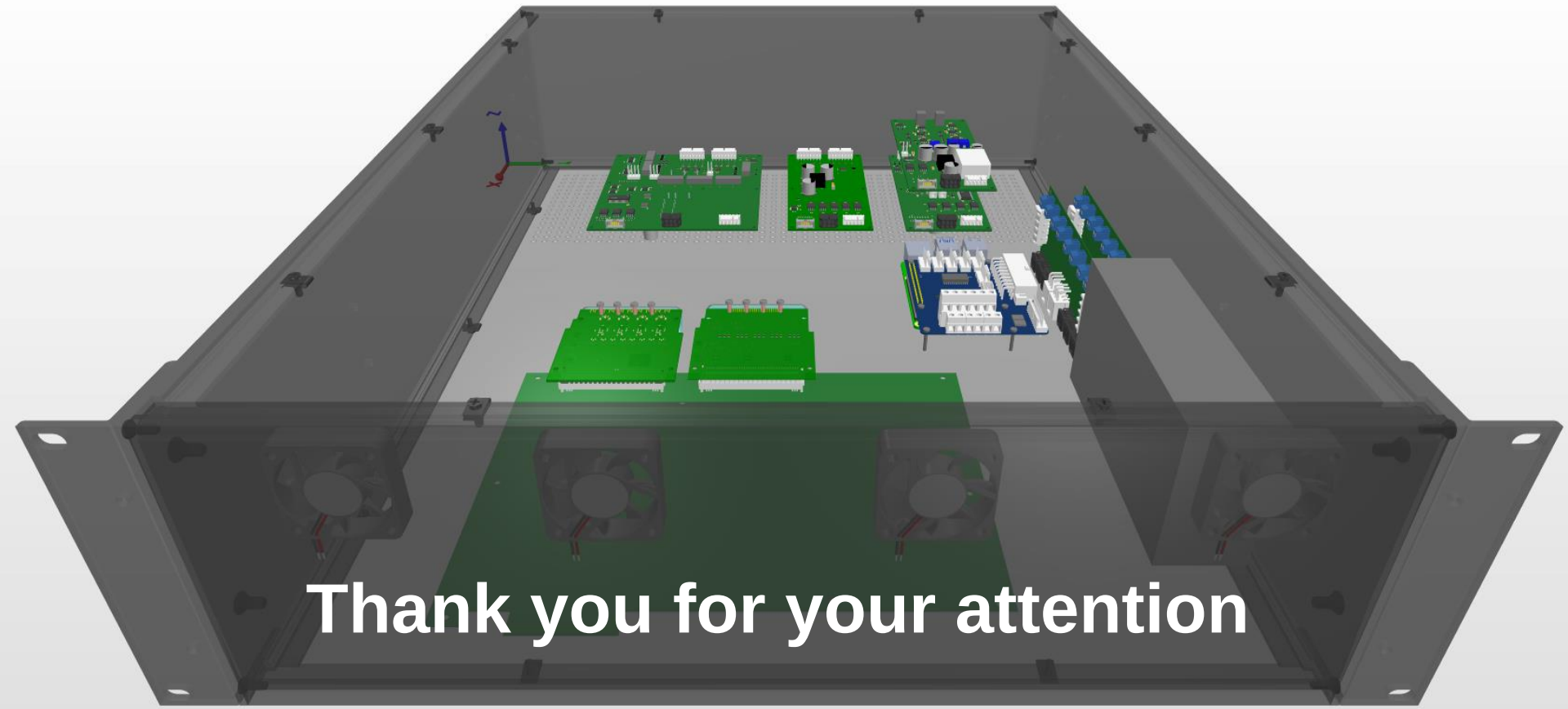
Test results discussion

- Management (control of individual power supplies) of all conditioning boards
- Maintaining environmental conditions (control of fan speed based on temperature and humidity readings from all conditioning boards in the system)
- Diagnostics of conditioning boards (reading of voltages and currents on boards)
- Watchdog for FPGA eval board

Full scale design plans

- Decision on final architecture
- Extended relay board to support all expected conditioning boards
- Extended management board to support diagnostic for all expected conditioning boards

Summary



Thank you for your attention