AUSTRIAN INSTITUTE OF TECHNOLOGY
TOMORROW TODAY

Challenges and Experiences using 4DIAC for Smart Grid Laboratory Automation

Successful Usage of the 4DIAC Environment

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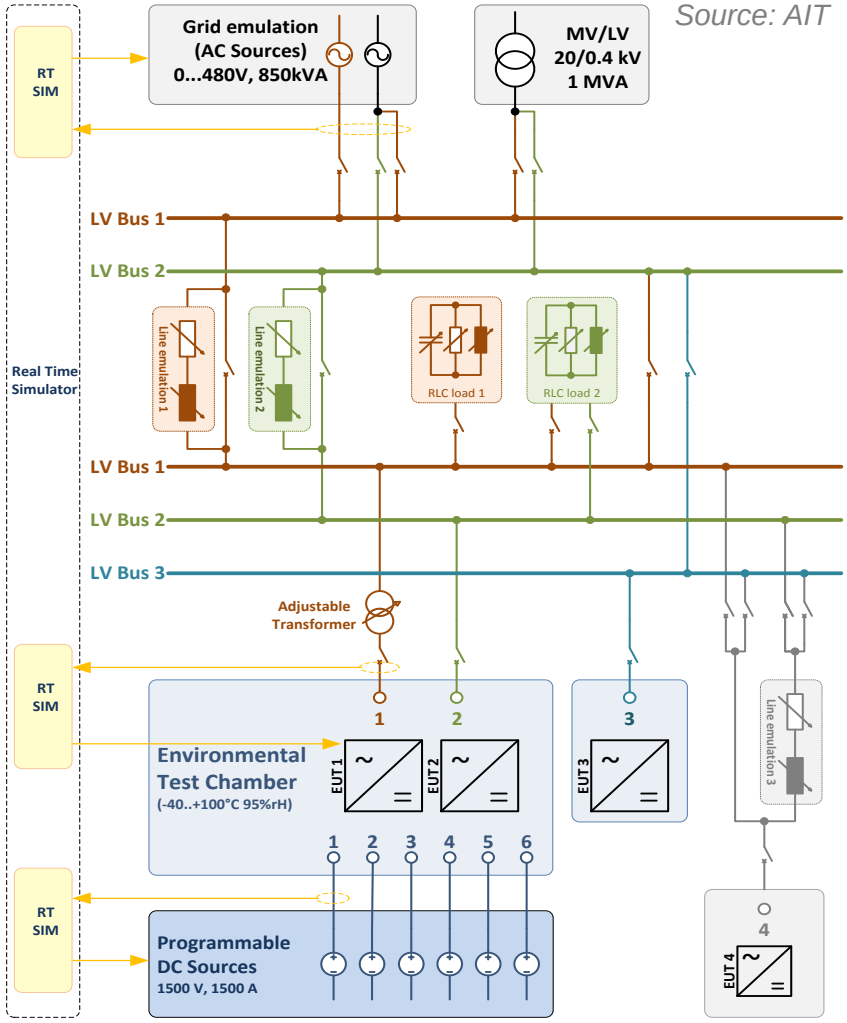
AIT SmartEST Laboratory

- 1 MW lab for Smart Grid component tests and system integration
  - Specialized on inverter tests
  - System tests with multiple components
  - Environmental tests
  - Simulation and validation
- Research, design and validation environment for Smart Grids
  - Component development
  - Automation concepts
  - Communication concepts
  - Design and validation



AIT SmartEST Laboratory

Requirements Automation System

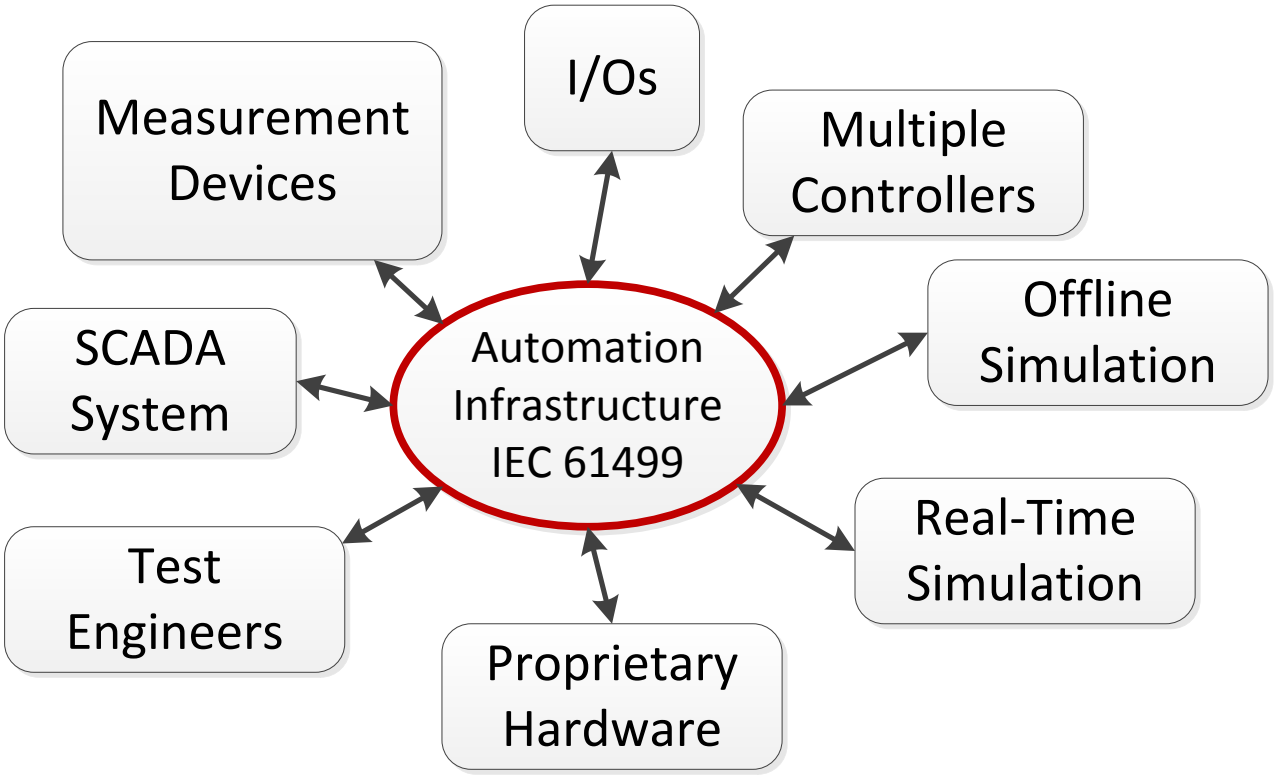
- High focus on safety
  - For personnel
  - For laboratory and test components
- Easy adaptability of control and safety functions
  - Test and safety procedures can change over the time
- Visualisation and HMI
  - SCADA, visualization and reporting
  - The main interface for the test engineer
  - How to handle and display large amount of information

Requirements Automation System

- All research concepts must NOT influence any test procedures
- Integration of new automation and control concepts for Smart Grids
  - Needs a flexible solution
  - Must be executable parallel to the test automation
- Communication concepts for Smart Grids
  - Possibility to easily exchange communication protocols
  - Support for different mediums
- Design and validation
  - Support for design and validation of new methods and concepts

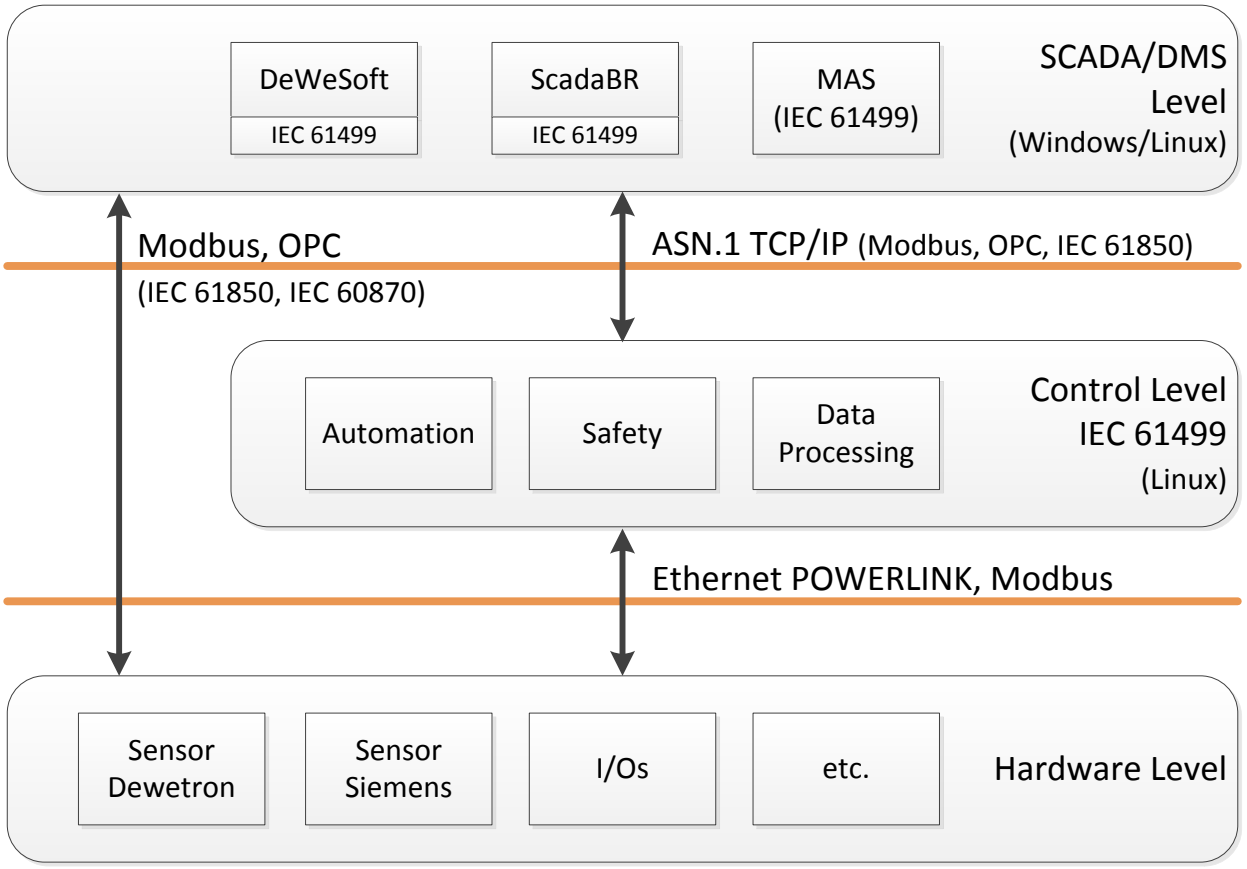
Automation System Overview and Design

- Hardware and software components



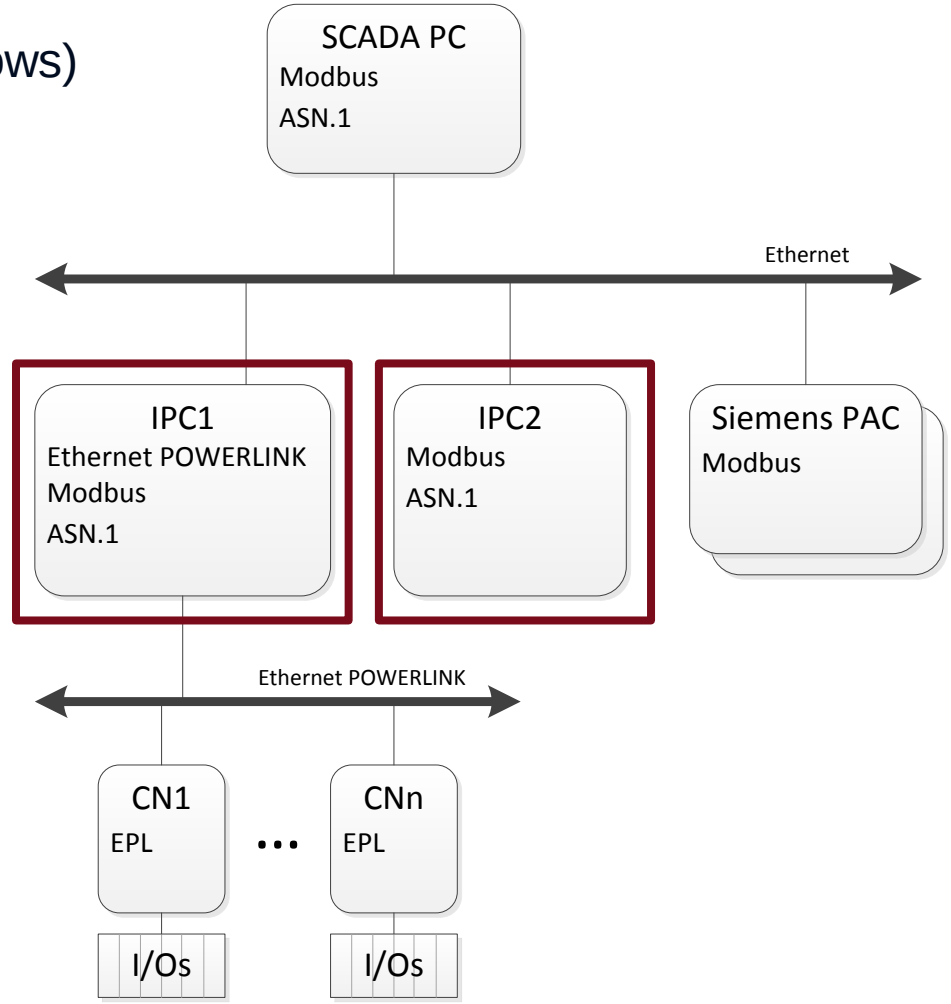
Automation System Overview and Design

- SCADA Layer
  - Supervisory ctrl
  - Alterations straightforward
- Control Layer
  - Basic control functionality
  - SW alterations possible, but not necessary
- Hardware Layer
  - Proprietary HW
  - No direct access to SW



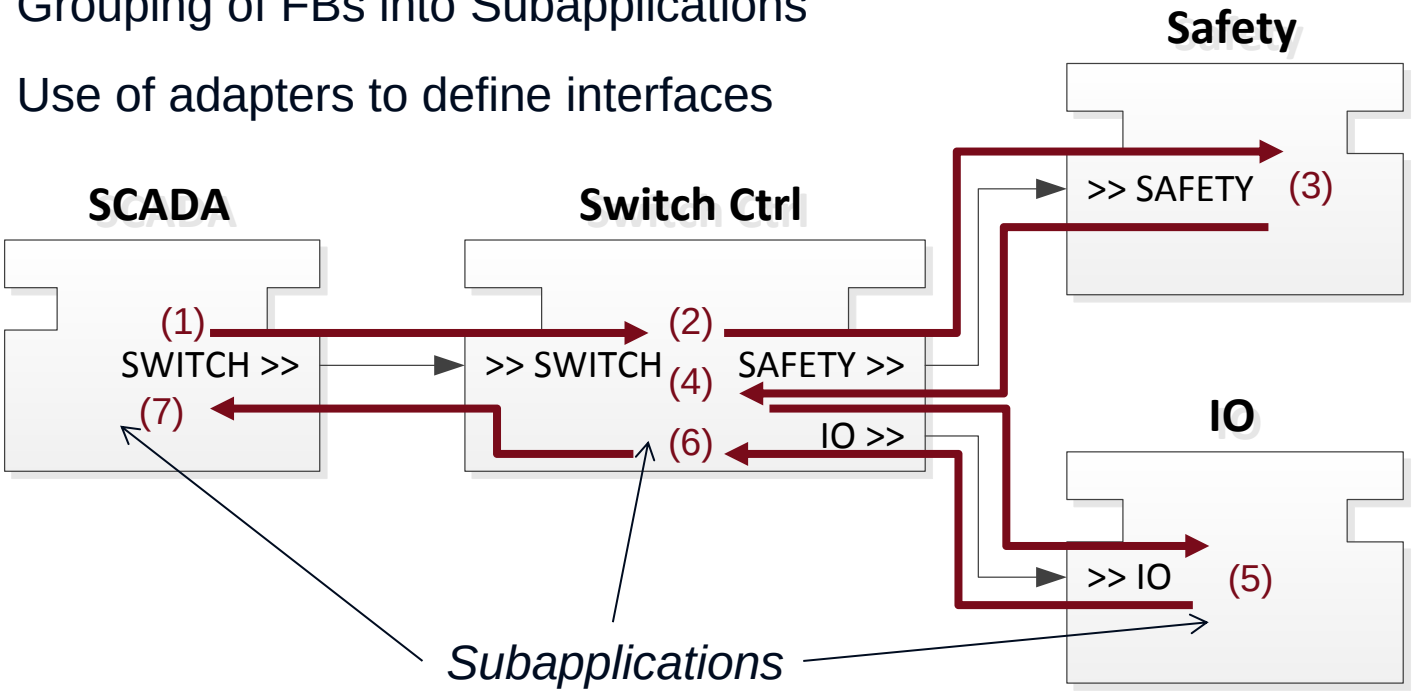
Automation System Overview and Design

- 1 SCADA PC with ScadaBR (Windows)
- 2 Industrial PCs with 4DIAC (Linux)
- B&R X20 I/O system with openPOWERLINK (EPL)
  - 16 client nodes
  - ~ 1.300 digital I/Os
- 22 Siemens PAC power measurement devices with libmodbus (Modbus/TCP)
  - ~ 700 measurement channels
- Other proprietary hardware
  - Grid & PV simulator
  - Precision measurement system



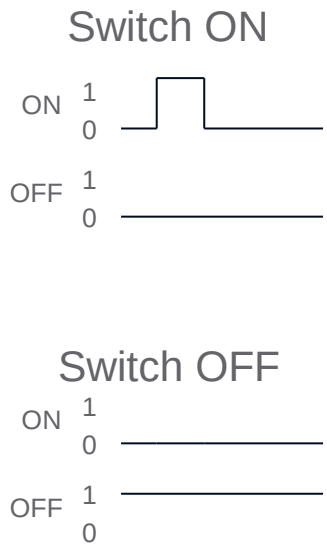
Implementation using 4DIAC

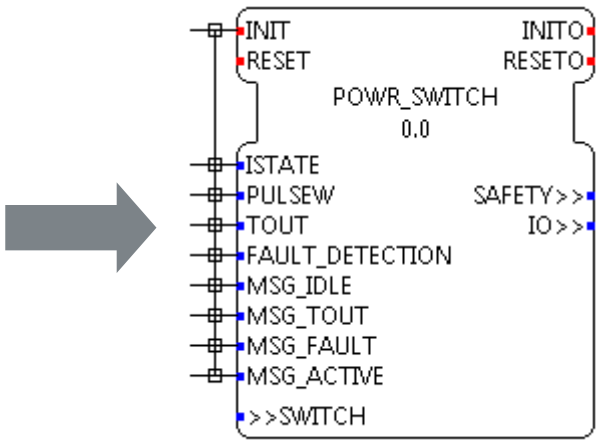
- Single application and a single resource
  - Consequence: very large and unclear applications
- Solution
  - Grouping of FBs into Subapplications
  - Use of adapters to define interfaces



Implementation using 4DIAC

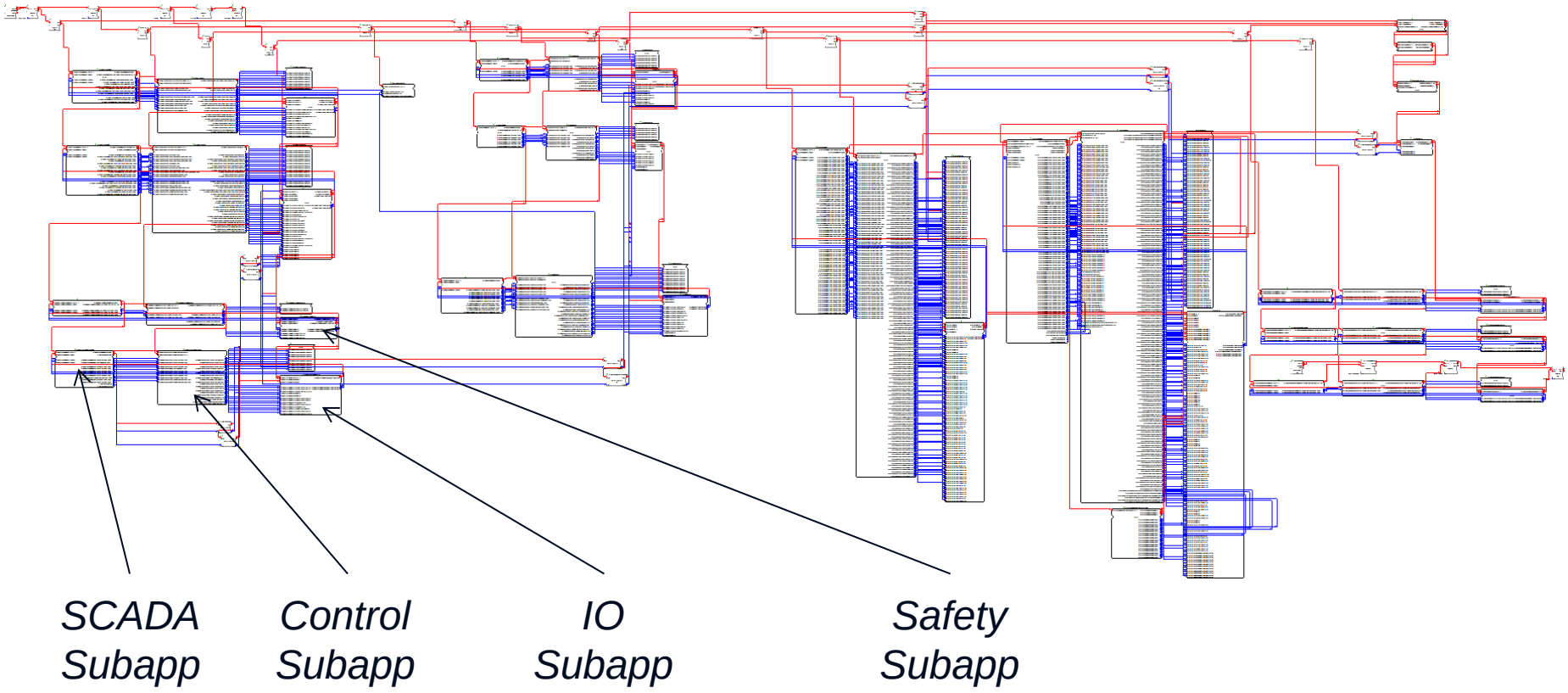
- Automation functionality (e.g., power switch control)
  - Control of power switches
    - Two control signals
  - Automatic switching sequence
    - Reference power value
    - Test sequence
  - Control of variable loads
    - Motor tuning





Implementation using 4DIAC

- Resulting control application



Summary and Conclusions

- Development of a Smart Grid lab automation using mainly open source tools
  - 4DIAC, ScadaBR, openPOWERLINK and libmodbus
  - Time consuming integration but very flexible and highly configurable
- 4DIAC as integrating middleware
  - Through portability available for multiple platforms, currently used on
    - Notebooks and standard PCs (Windows and Linux)
    - Industrial PC (Windows Embedded and Linux)
    - Embedded Controllers (Embedded Linux)
  - As common interface between SmartEST and other automation projects
    - Portability and exchangeability of control applications
    - Configurable communication gateway to Smart Grid components (e.g., intelligent inverter systems)

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