AUSTRIAN INSTITUTE OF TECHNOLOGY
TOMORROW TODAY

Open Source based Automation for Smart Grids

Experiences with DERri JaNDER in AIT Smart Grid Labs and Challenges and experiences using open source software for lab automation

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DTU RTLabOS: From Interoperability to System Integration

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Outline

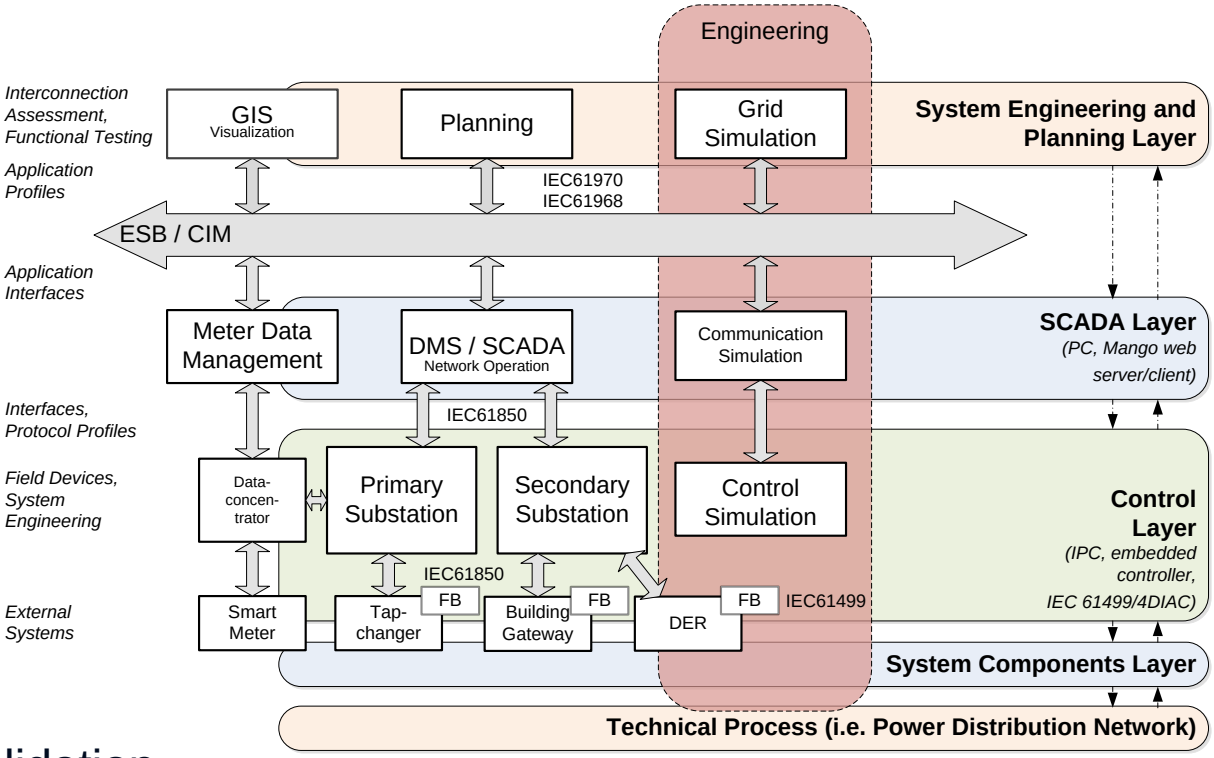
- Motivation and Challenges
- Open Source Software for Laboratory Automation
- Experiences with DERri JaNDER
- Future Activities

Motivation and Challenges

- Requirements for developing, testing & validating Smart Grid ICT-concepts
  - Hardware requirements
    - Flexibility
    - Scalability
    - Hardware independence
  - Software and application requirements
    - Configurability
    - Portability
    - Application distribution
  - Simulation requirements
    - Offline simulation
    - Real-time simulation
  - Open and standard-compliant implementation
    - Interoperability
    - Open communication interfaces
    - Free & open source approaches

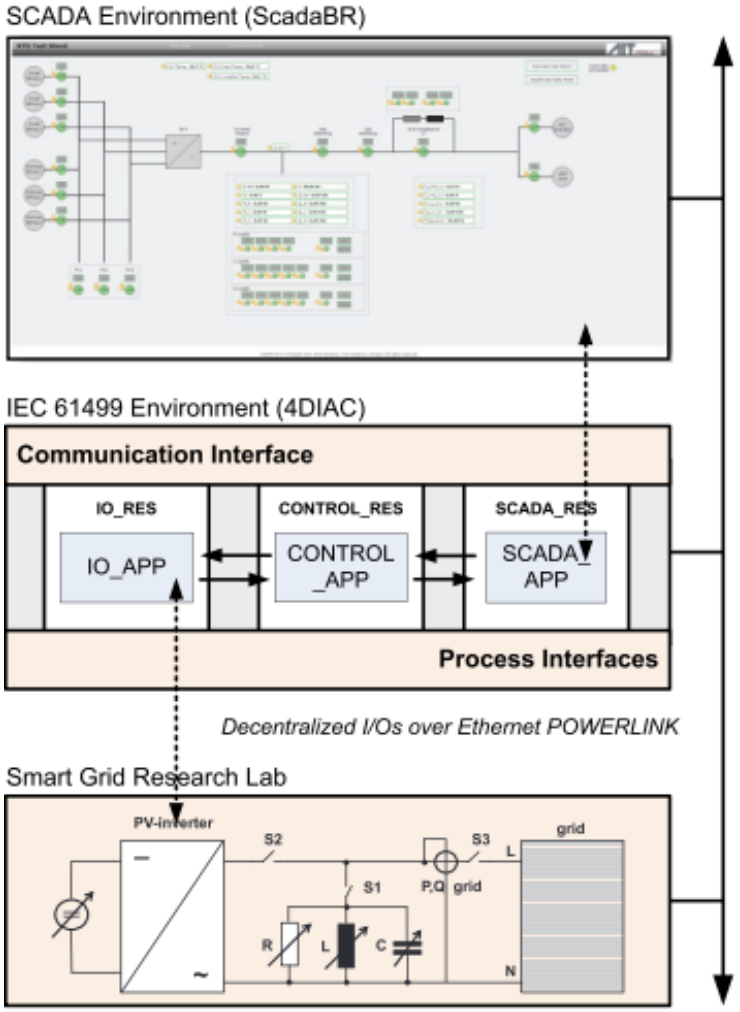
Open Source Software for Laboratory Automation

- Research challenges
  - Architecture
  - Models
  - Protocols
  - Implementation
- Activities
  - SCADA/ controller environment
  - Use case based validation in the laboratory environment
  - Standard-compliant approach (IEC, ISO, IEEE, etc.)



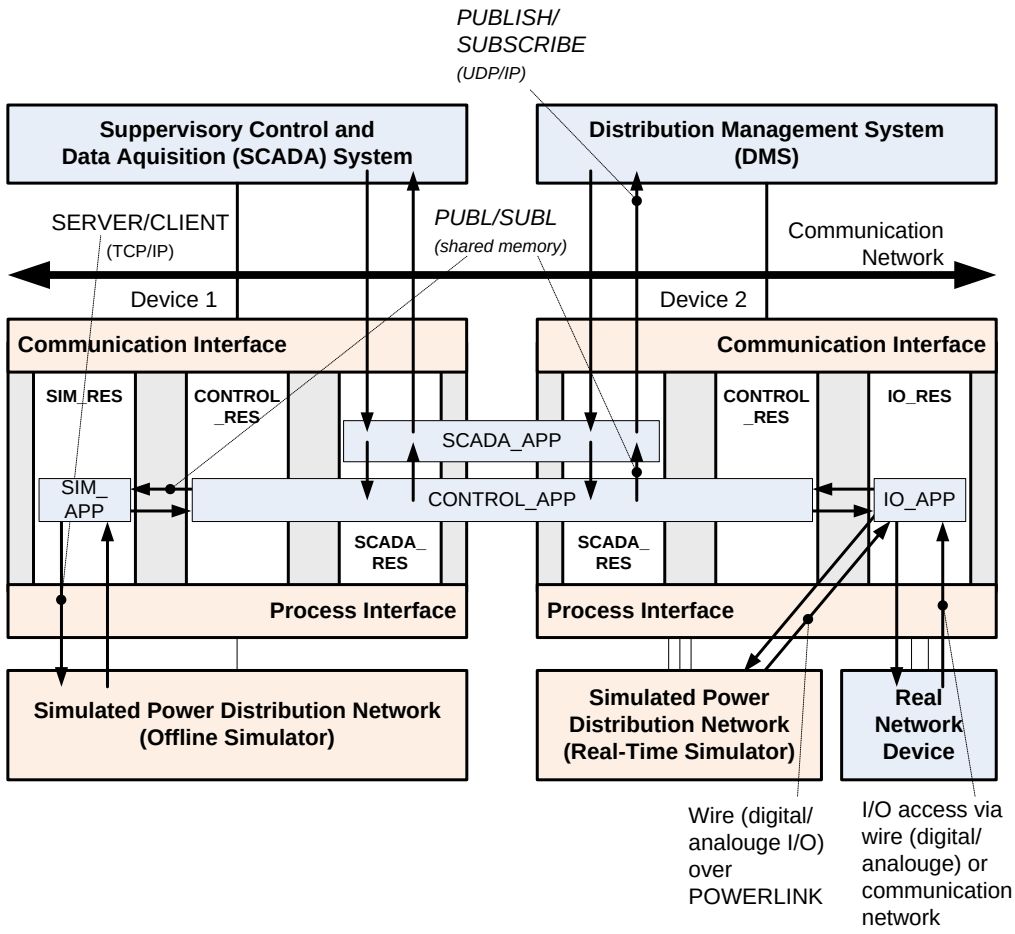
Open Source Software for Laboratory Automation

- Automation architecture
  - SCADA Layer
    - Superior control functions
    - Alterations straightforward
  - Control Layer
    - Basic control functionality
    - Software alterations possible, but not necessary
  - Hardware Layer
    - Proprietary hardware
    - No access to software



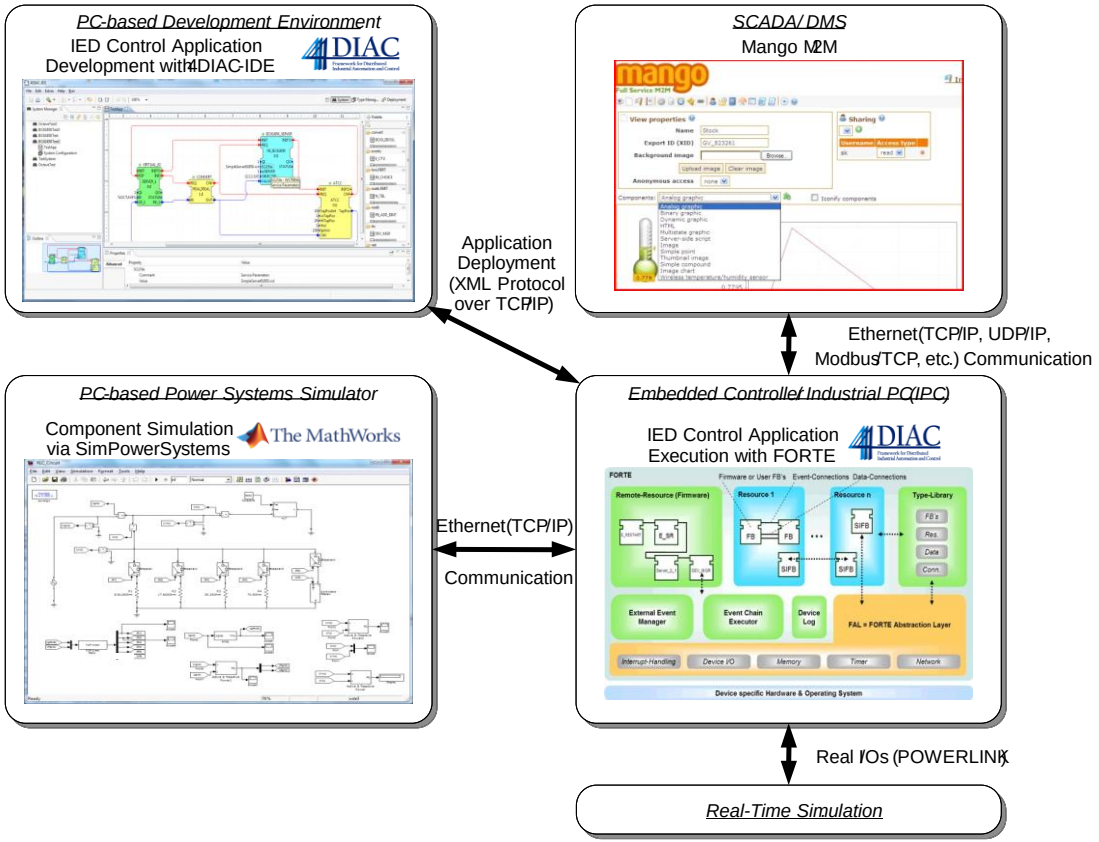
Open Source Software for Laboratory Automation

- IEC 61850/IEC 61499 system architecture & generic communication interfaces
  - Multiple systems
    - SCADA/DMS
    - Simulators
    - Controllers
  - Independent applications
    - Control application
    - Communication application(s)



Open Source Software for Laboratory Automation

- Visualisation and Simulation Tools
  - SCADA for visualisation and logging
    - ScadaBR
  - Simulation tools for validation
    - Matlab/Simulink
    - PSAT
    - DIgSILENT / PowerFactory
    - OpalRT (real-time)



Open Source Software for Laboratory Automation

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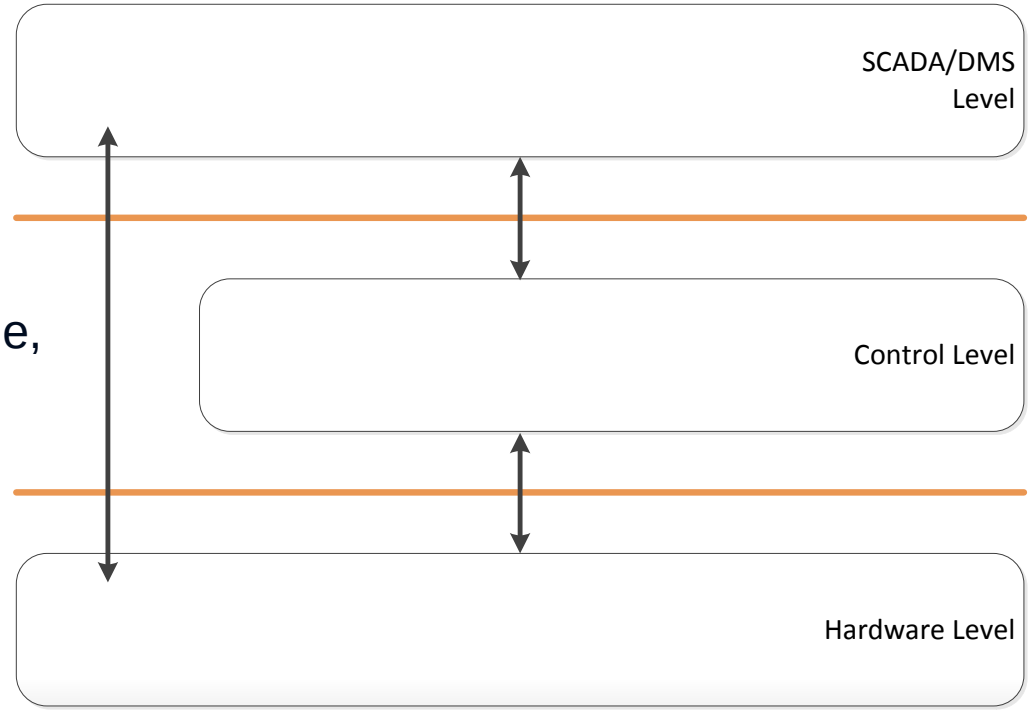
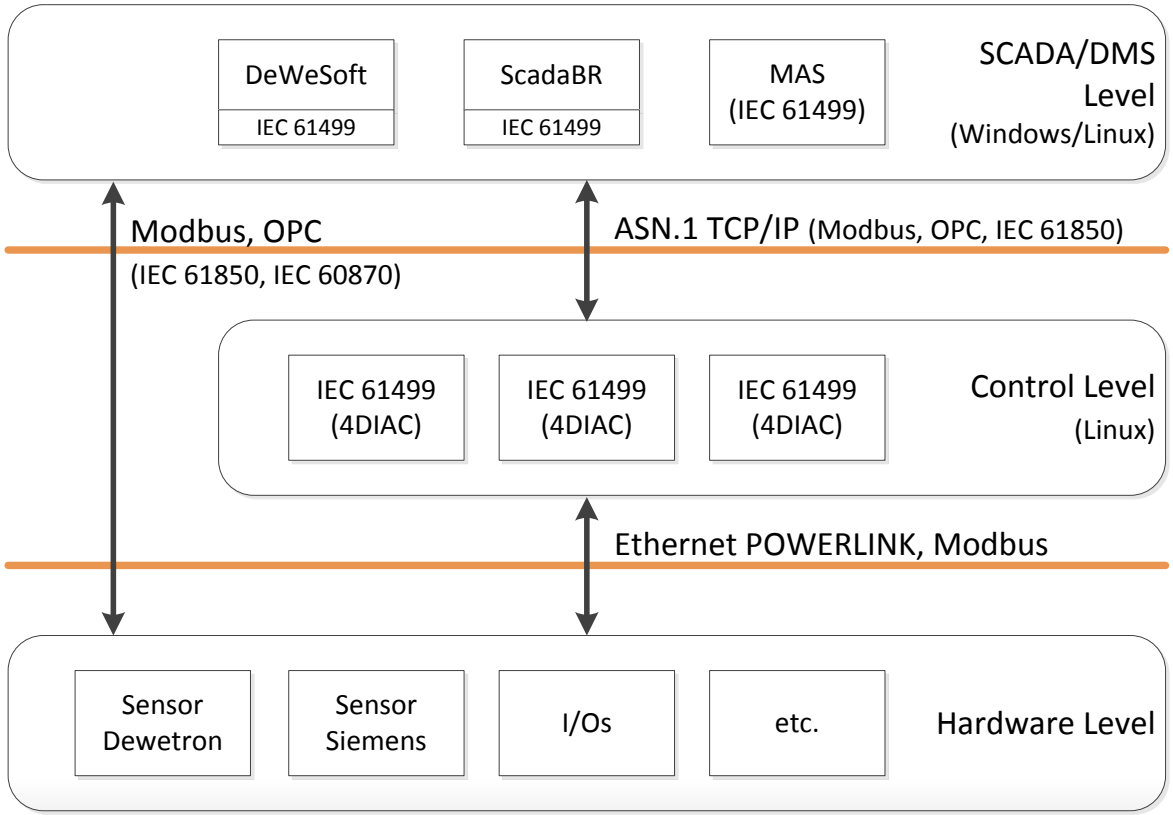


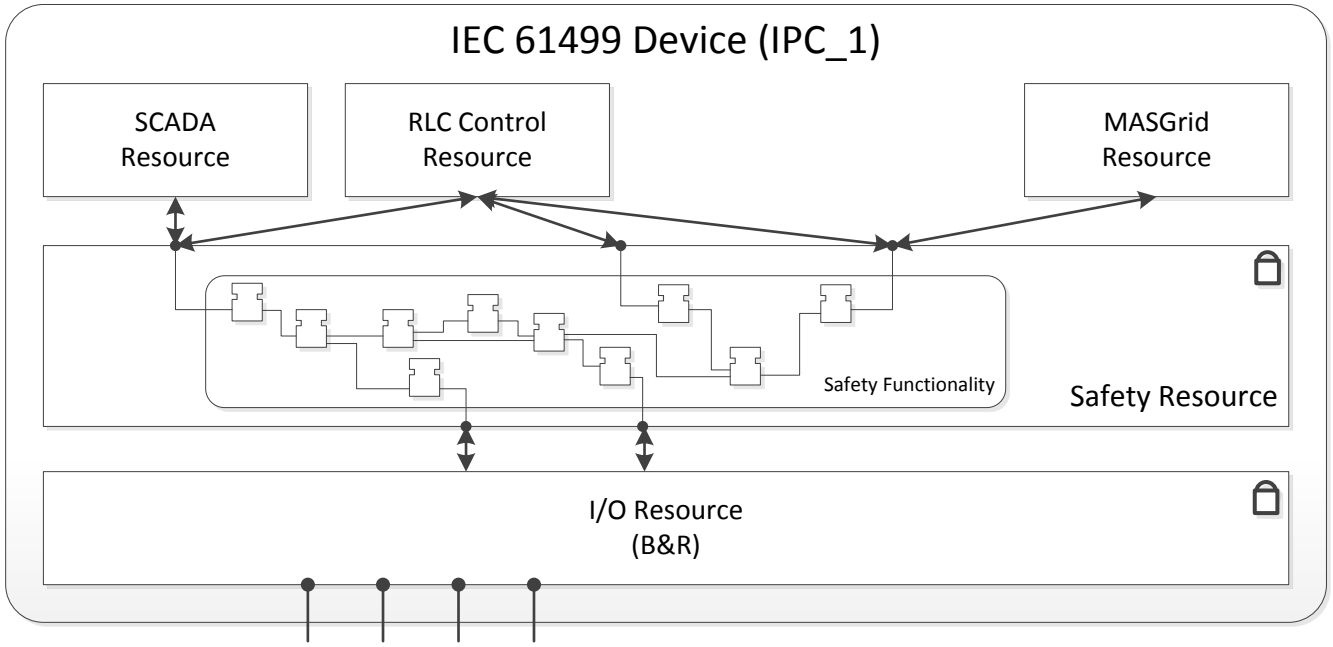
Open Source Software for Laboratory Automation

- Layer components and communication
  - Fix components
    - Sensors, I/Os
  - Main control components
    - IEC 61499 applications
    - ScadaBR
  - Additional components
    - Multi-Agent System ...



Open Source Software for Laboratory Automation

- Control Level Implementation using 4DIAC
  - IEC 61499 device for laboratory control
  - I/O and Safety Resources are locked in the device

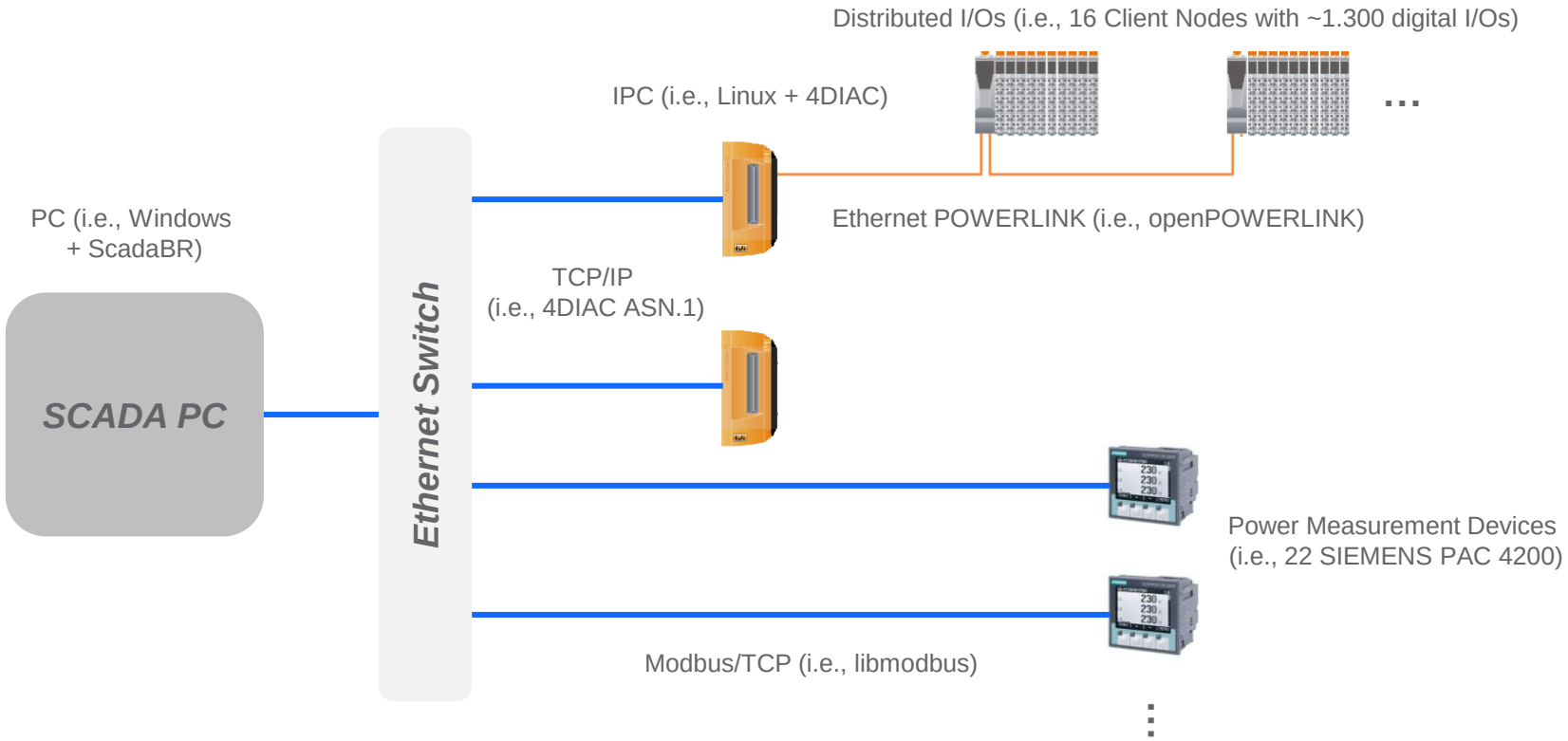


Open Source Software for Laboratory Automation

- Implementation example: AIT SmartEST Laboratory
  - SCADA layer with ScadaBR (1PC running Windows)
    - Visualisation, user interaction, logging, monitoring
  - Control layer with 4DIAC (2 IPC running Linux)
    - ~ 1300 digital I/Os used for controlling the power switches and feedback signals (e.g., from emergency system, status of measurement devices)
    - ~ 700 measurement signals
  - Hardware layer
    - 16 modular I/O modules from B&R connected via openPOWERLINK to the control layer (4DIAC)
    - 22 power measurement devices from Siemens connected via libmodus to the control layer (4DIAC)

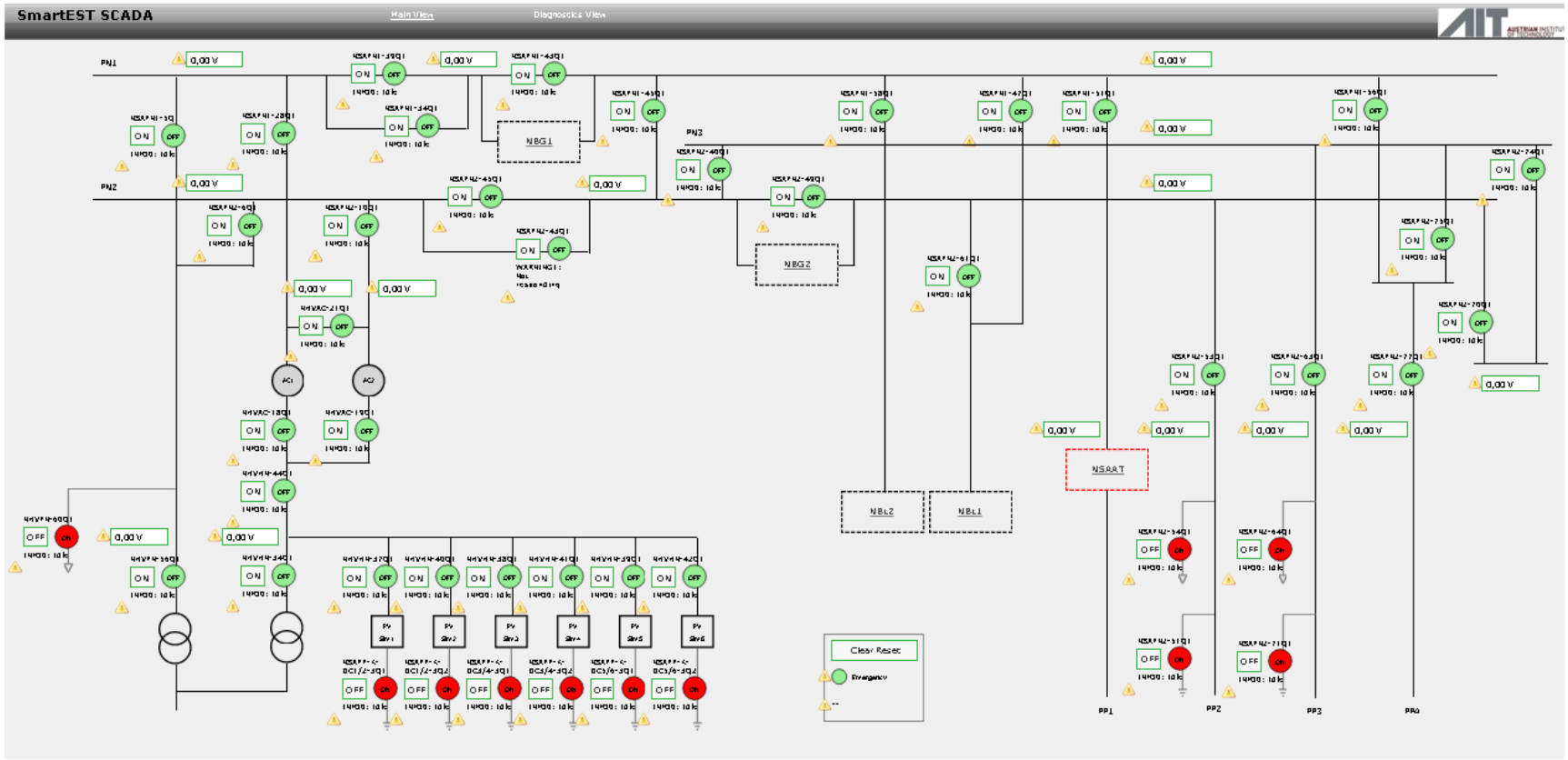
Open Source Software for Laboratory Automation

- Implementation example: AIT SmartEST Laboratory
  - Hardware infrastructure



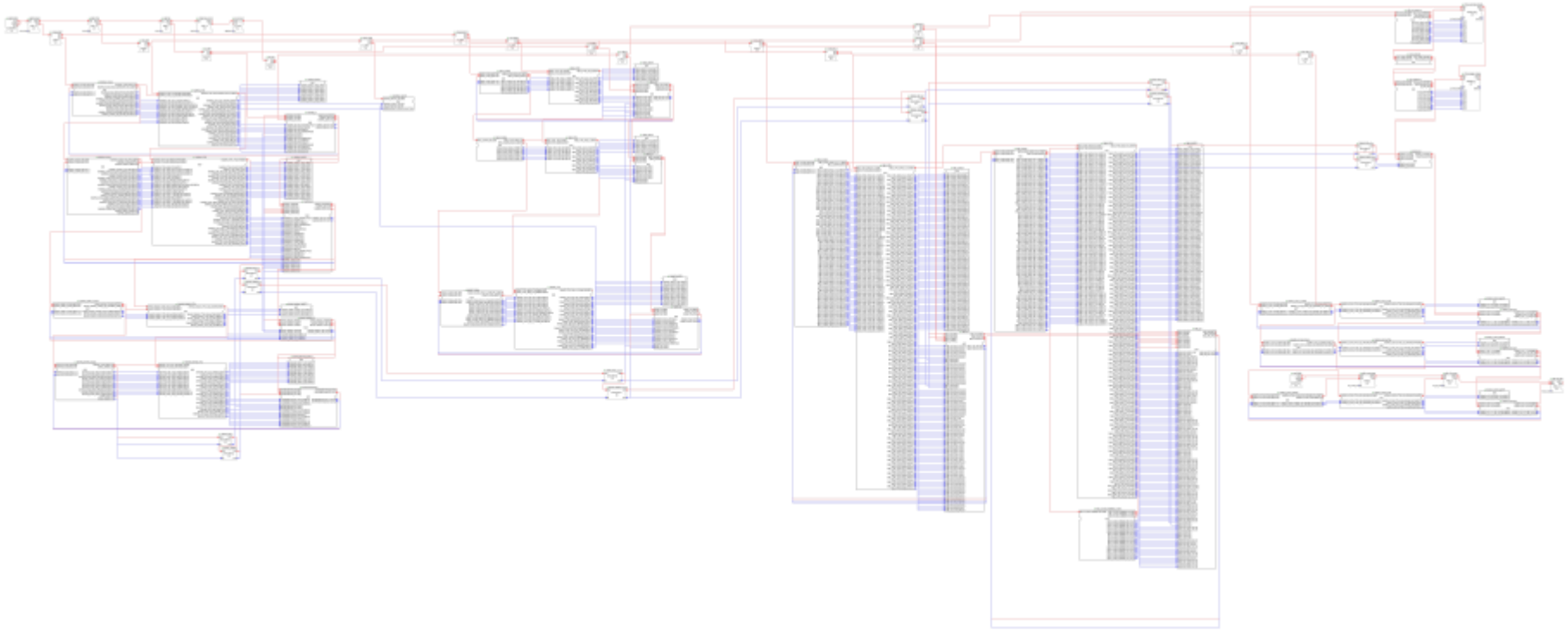
Open Source Software for Laboratory Automation

- Implementation example: AIT SmartEST Laboratory
  - SCADA interface



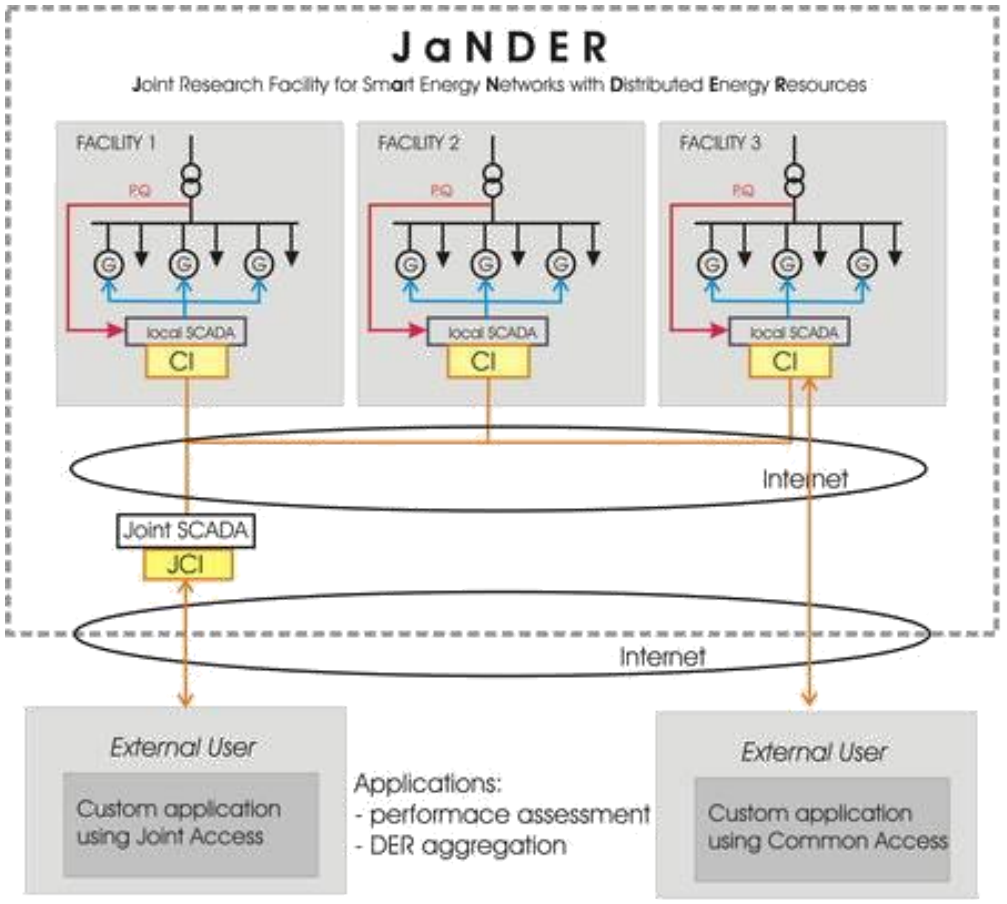
Open Source Software for Laboratory Automation

- Implementation example: AIT SmartEST Laboratory
  - Control application



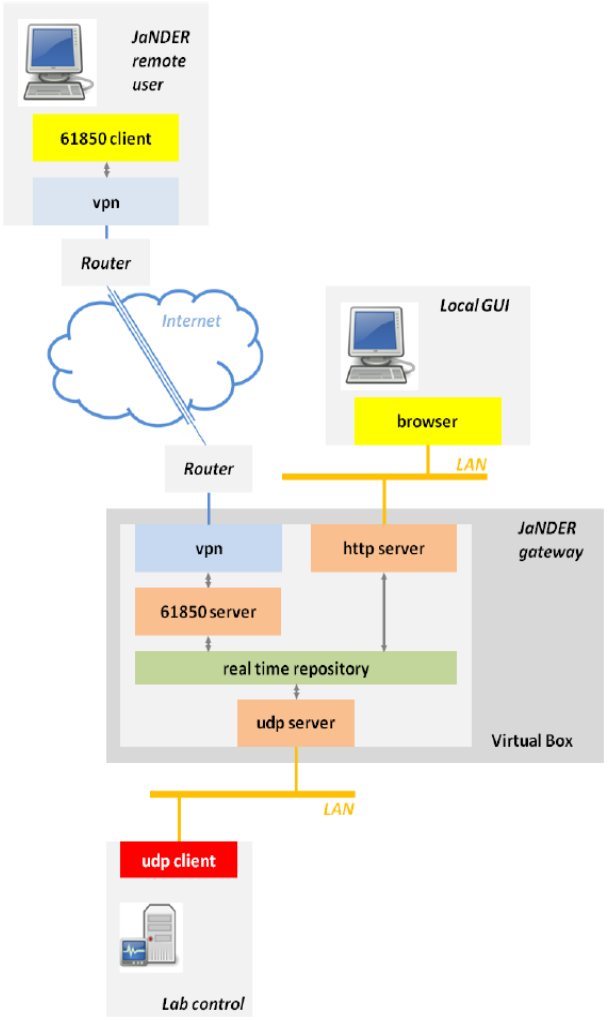
Experiences with DERri JaNDER

- Idea/concept



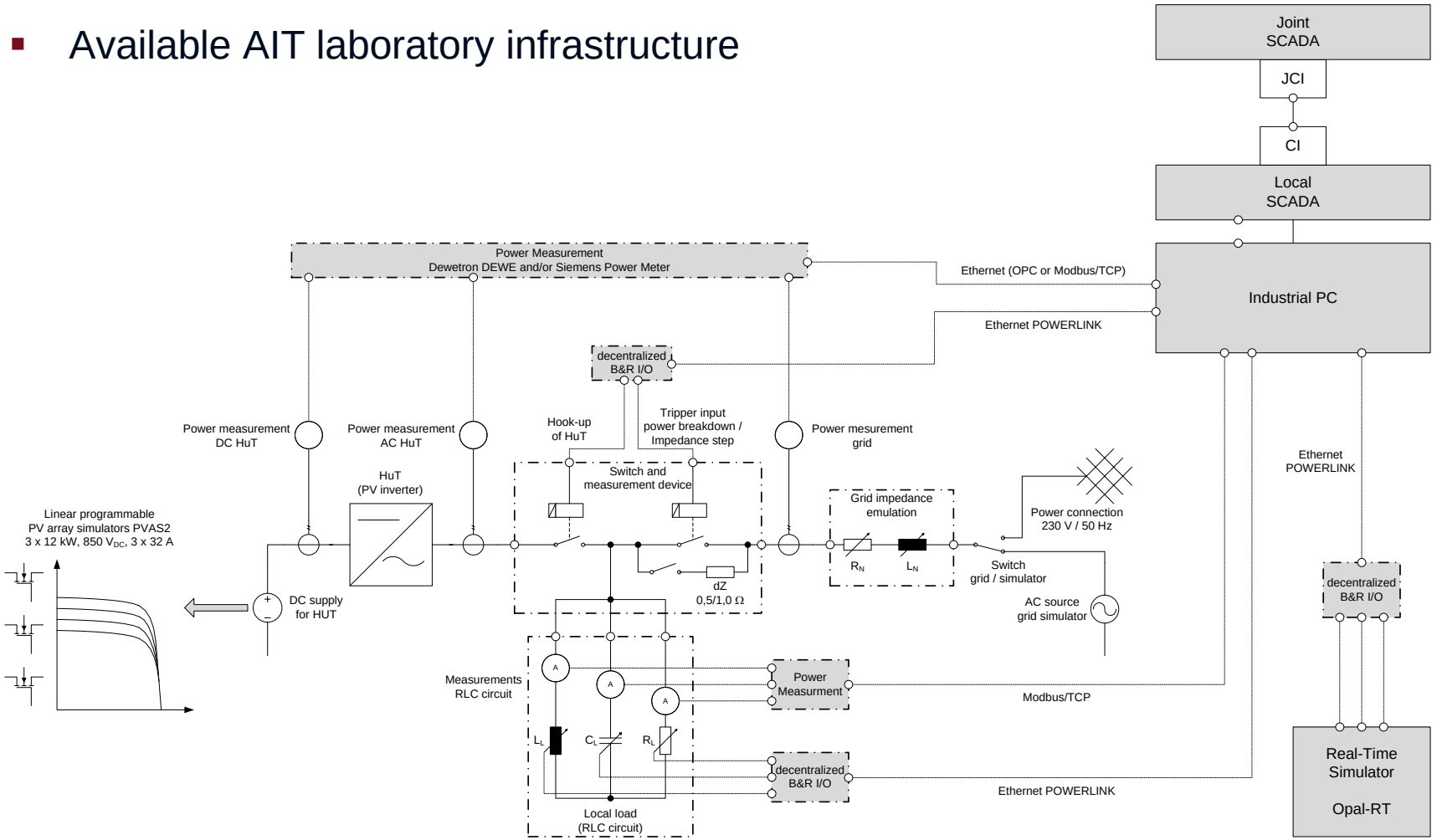
Experiences with DERri JaNDER

- Solution



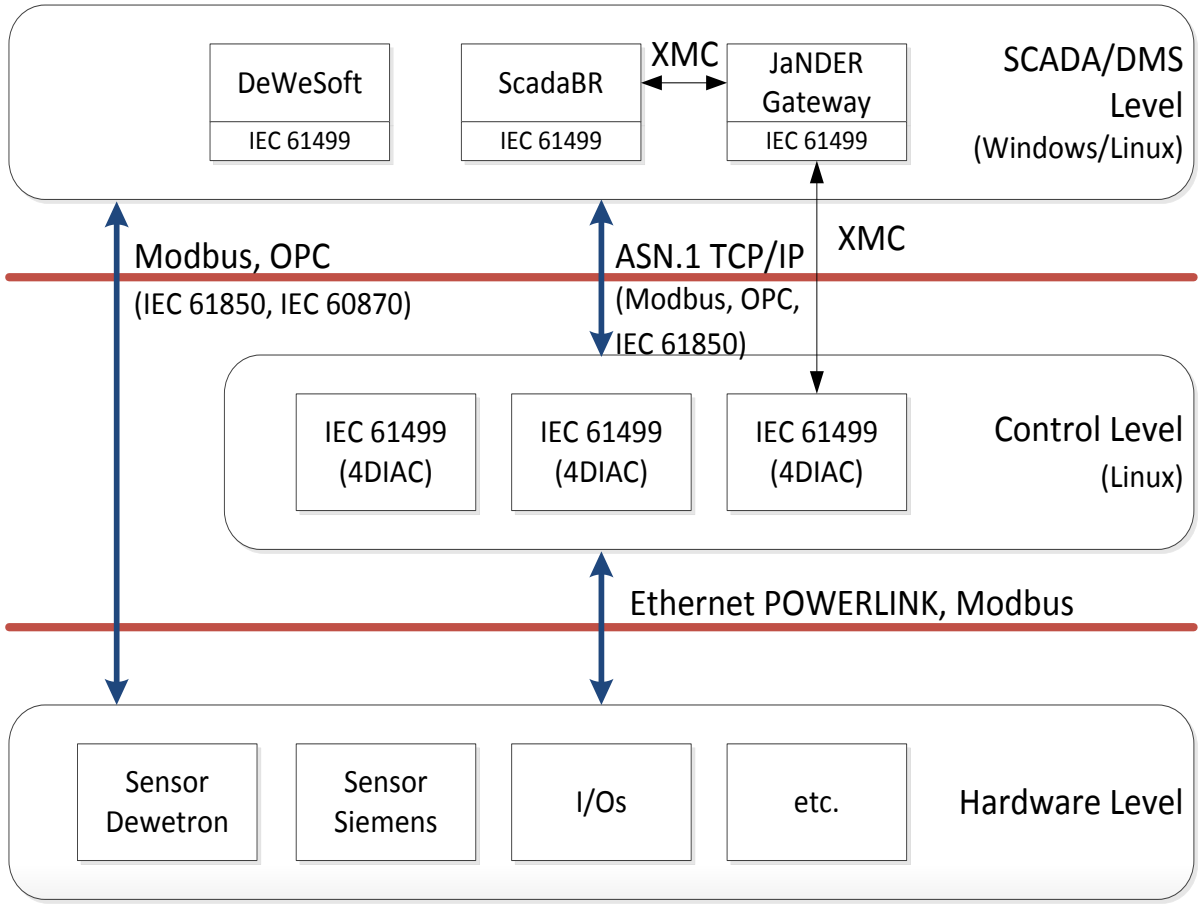
Experiences with DERri JaNDER

- Available AIT laboratory infrastructure



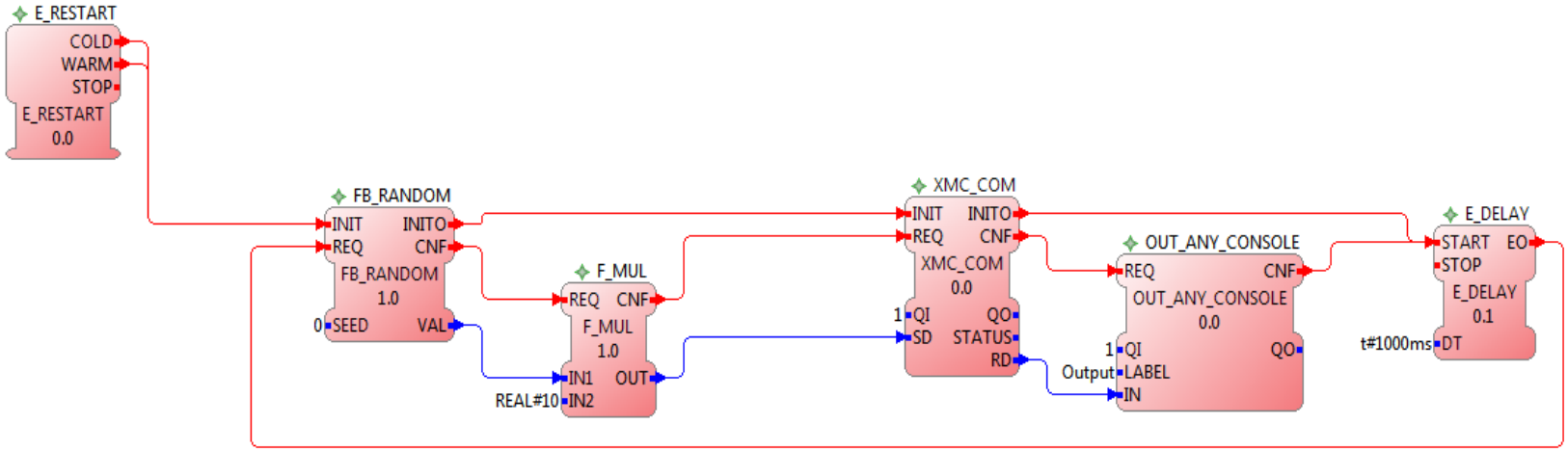
Experiences with DERri JaNDER

- Integration AIT laboratory infrastructure
  - Automation structure



Experiences with DERri JaNDER

- Integration AIT laboratory infrastructure
  - Connectio to JaNDER Gateway with IEC 61499 application

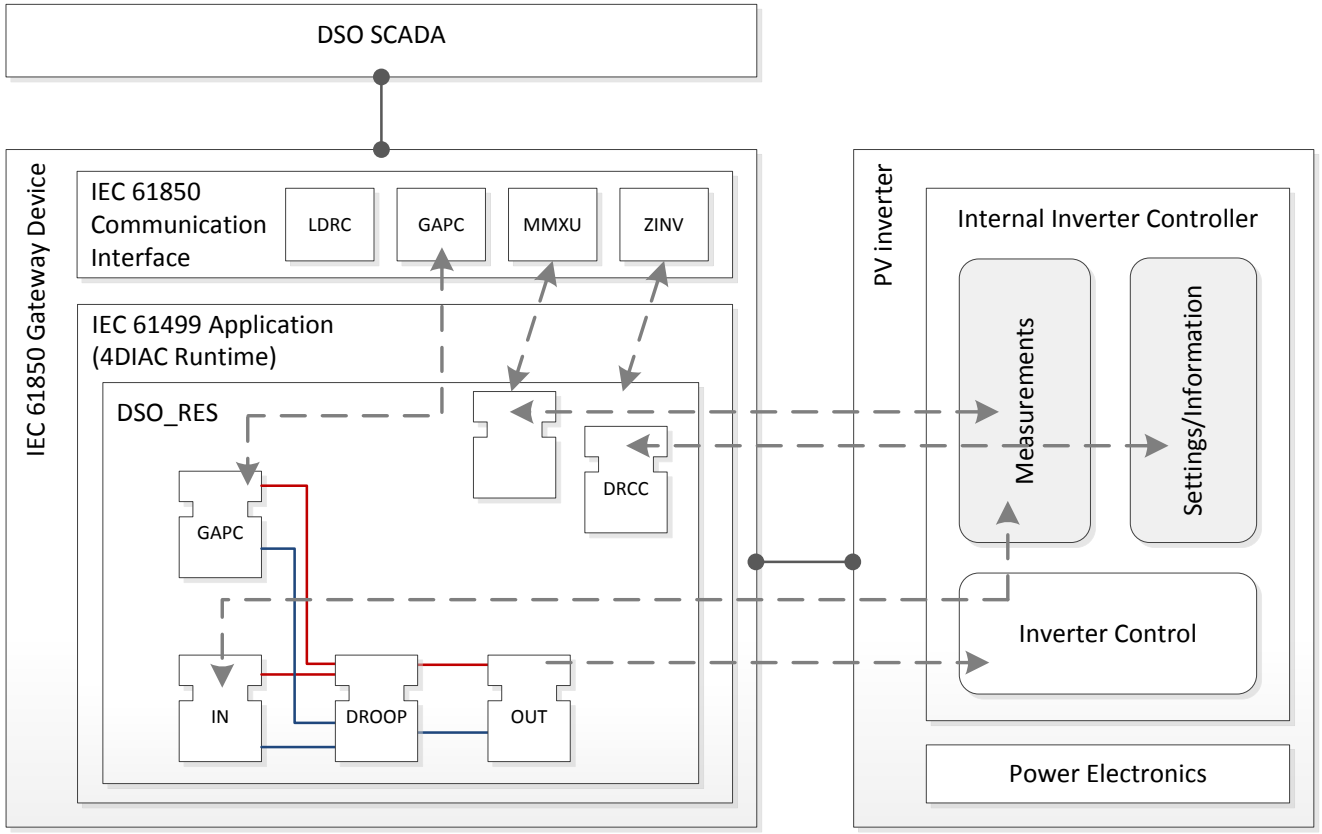


Future Activities

- Development of an IEC 61499 function block library for Smart Grids applications
  - User documentation
  - Provision as 4DIAC open source module under the EPL
- Integration of IEC 61850 interoperability and communication approach with IEC 61499/4DIAC
  - Proper mapping of IEC 61850 elements to IEC 61499
  - Development of IEC 61499 Service Interface Function Blocks supporting IEC 61850

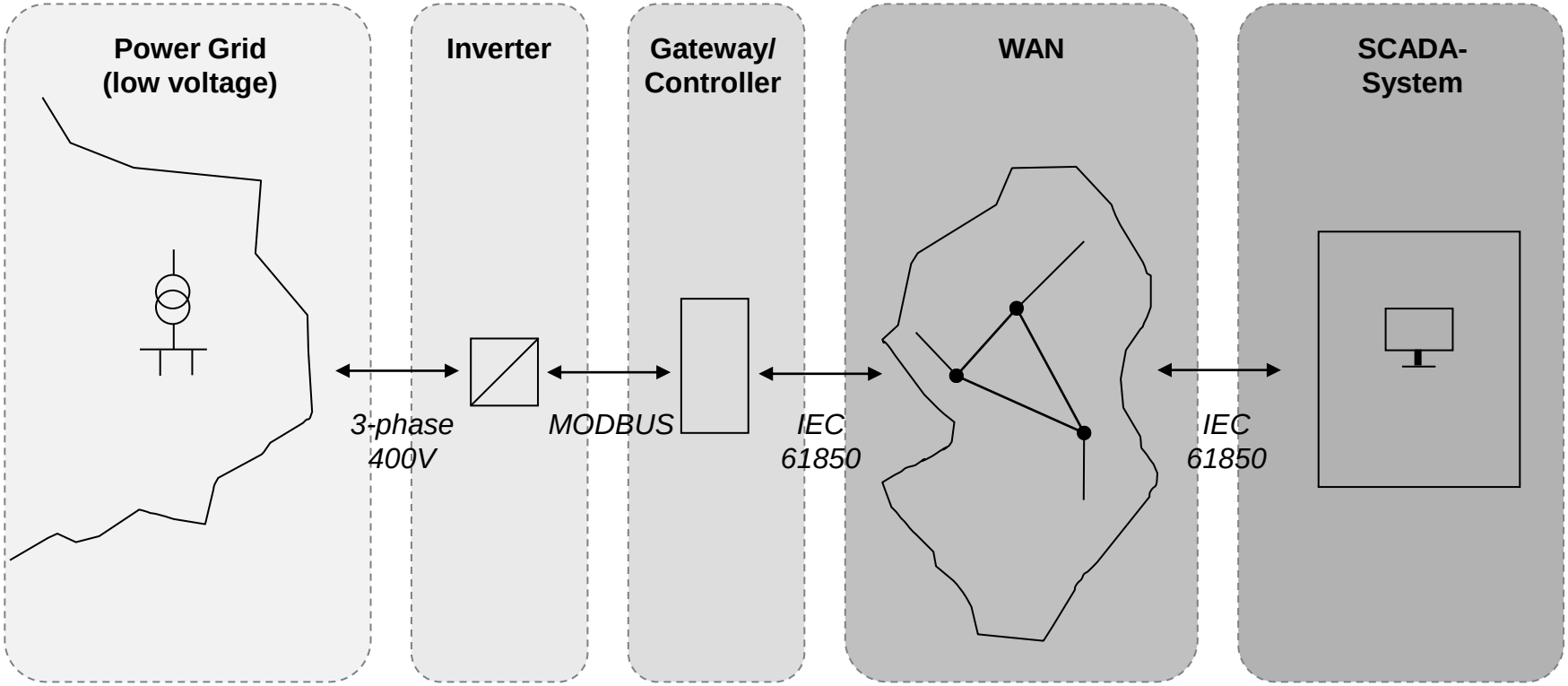
Future Activities

- Development of an IEC 61499 Compliance Profile for Smart Grids and implementation of it in 4DIAC (incl. IEC 61850 and reconfiguration)



Future Activities

- Development of a flexible validation infrastructure
  - Using co-simulation and hardware-in-the-loop concepts



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