AUSTRIAN INSTITUTE OF TECHNOLOGY
TOMORROW TODAY

IEC 61499/4DIAC Applications for the Power and Energy Domain

Successful Usage of the 4DIAC Environment

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3rd 4DIAC User's Workshop (4DIAC)

17th IEEE International Conference on
Emerging Technologies and Factory Automation (ETFA'2012)
September 17-21, 2012, Kraków, Poland

IEEE 1951-2011 60th anniversary

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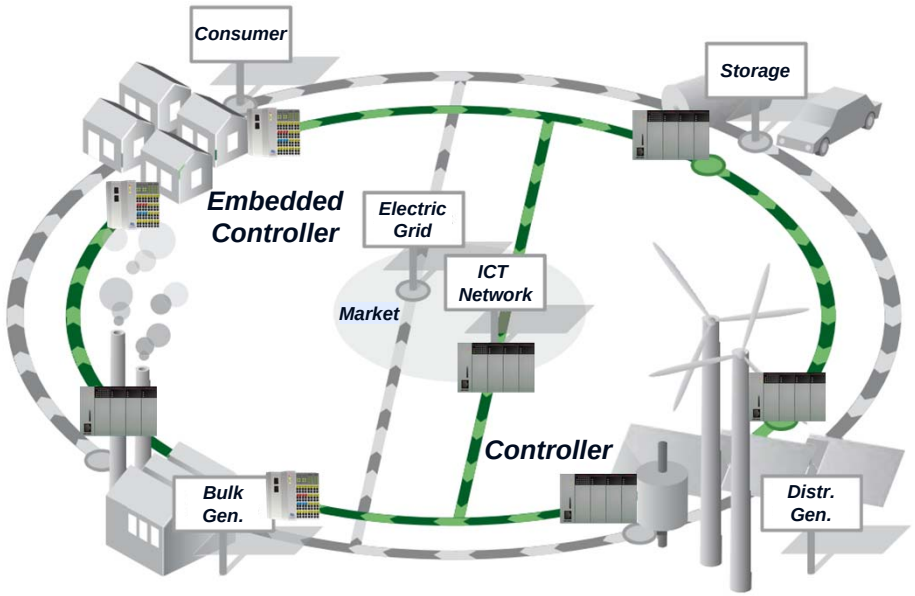
Introduction and Background

Usage of IEC 61499 / 4DIAC for Smart Grids Applications?

- Smart Grids: modernisation of energy and power distribution networks
- Internet of Energy
  - Energy Grids + ICT Network
  - Bi-directional energy and communication flow
- Management of Smart Energy Grids requires innovative ICT technologies
  - Advanced automation concepts and algorithms (IEC 61499)
  - Advanced communication concepts (IEC 61850)
  - Intelligent grid components (inverters, controllers, meters, etc.)
  - Interoperability of systems and components
  - Standard-based implementation as key requirement for future developments



Co-Simulation of Electrical Grids and ICT in Lectures

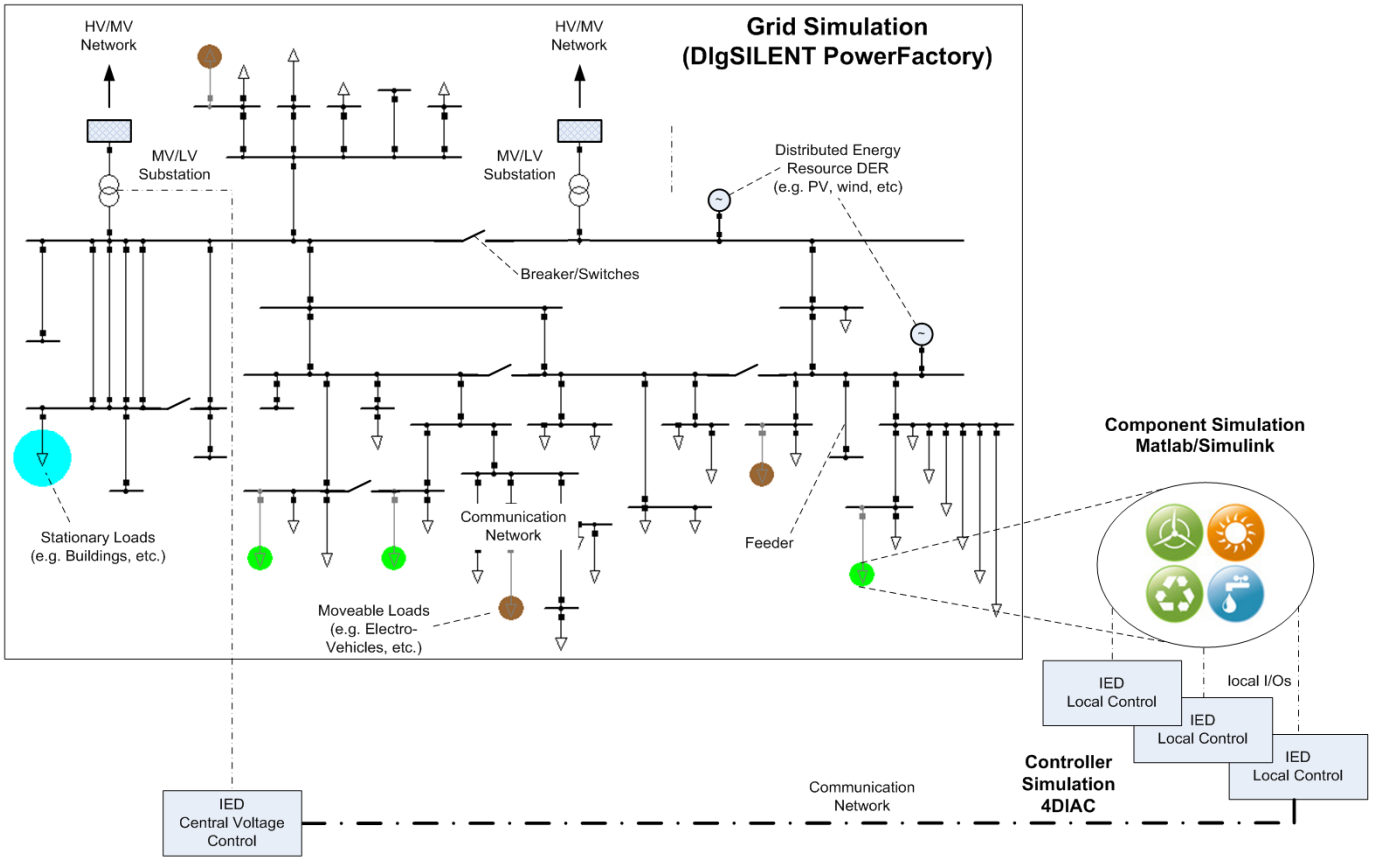
Control Simulation with 4DIAC

- Motivation and goals
  - Teaching of the basic principles for the co-simulation of electrical grids and control systems at University of Applied Sciences Technikum Vienna
  - Introduction of a co-simulation environment
  - Modeling of electricity grid and its components
  - Development of control algorithms with IEC 61499 function blocks
  - Monitoring and visualization with a supervisory control system (i.e., SCADA)

Co-Simulation of Electrical Grids and ICT in Lectures

Control Simulation with 4DIAC

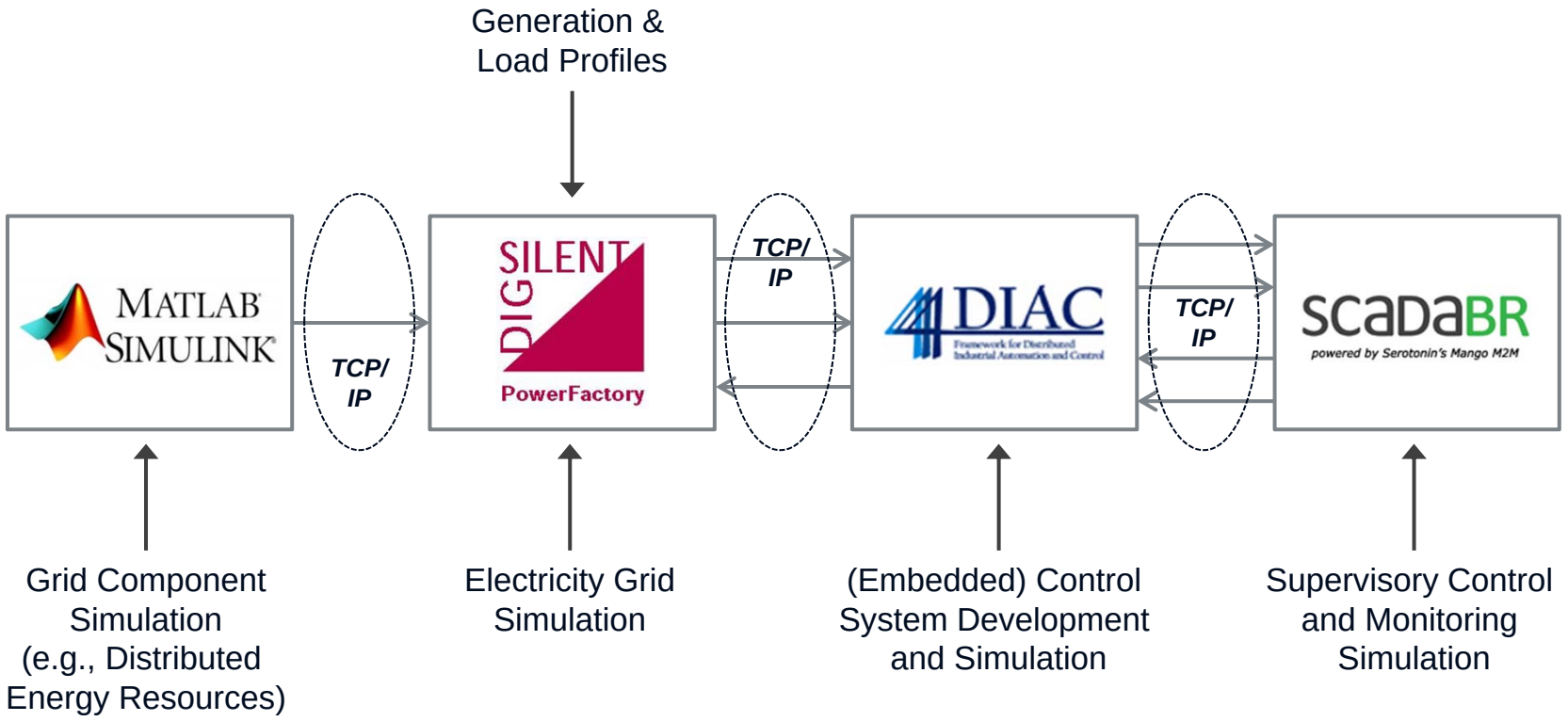
- Co-simulation concept



Co-Simulation of Electrical Grids and ICT in Lectures

Control Simulation with 4DIAC

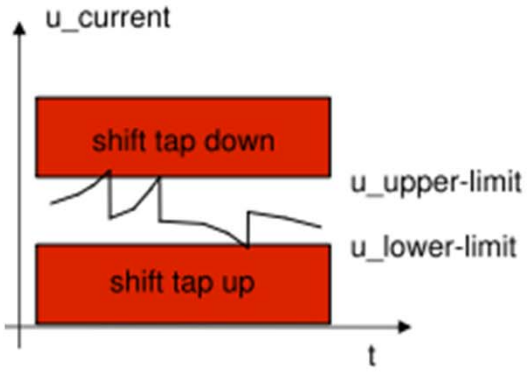
- Communication architecture



Co-Simulation of Electrical Grids and ICT in Lectures

Control Simulation with 4DIAC

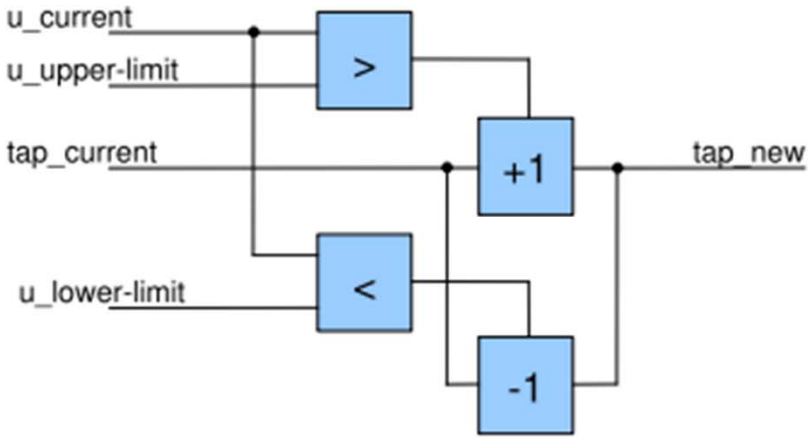
- Under-Load-Tap-Changer (ULTC) algorithm



Parameter
- u_upper-limit
- u_lower-limit

Input Variablen
- u_current
- tap_current

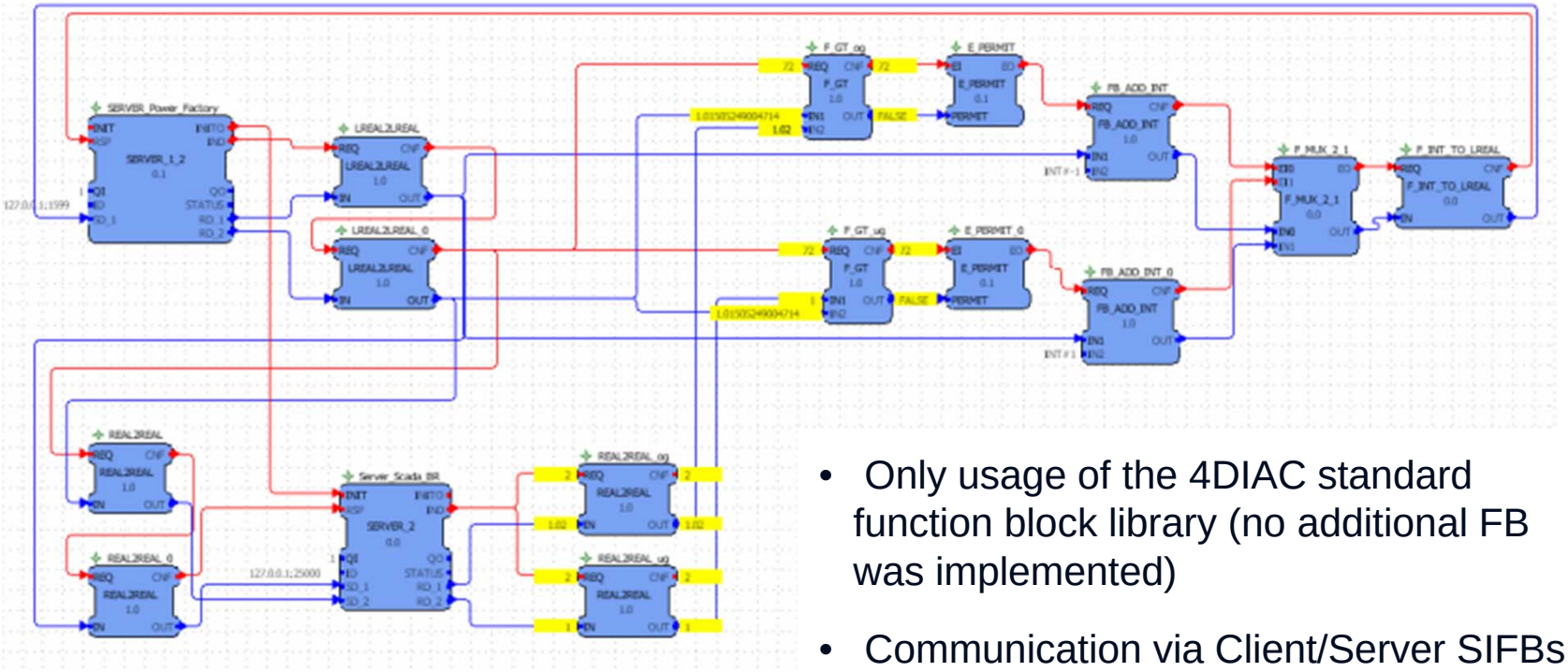
Output Variablen
- tap_new



Co-Simulation of Electrical Grids and ICT in Lectures

Control Simulation with 4DIAC

- ULTC 4DIAC implementation

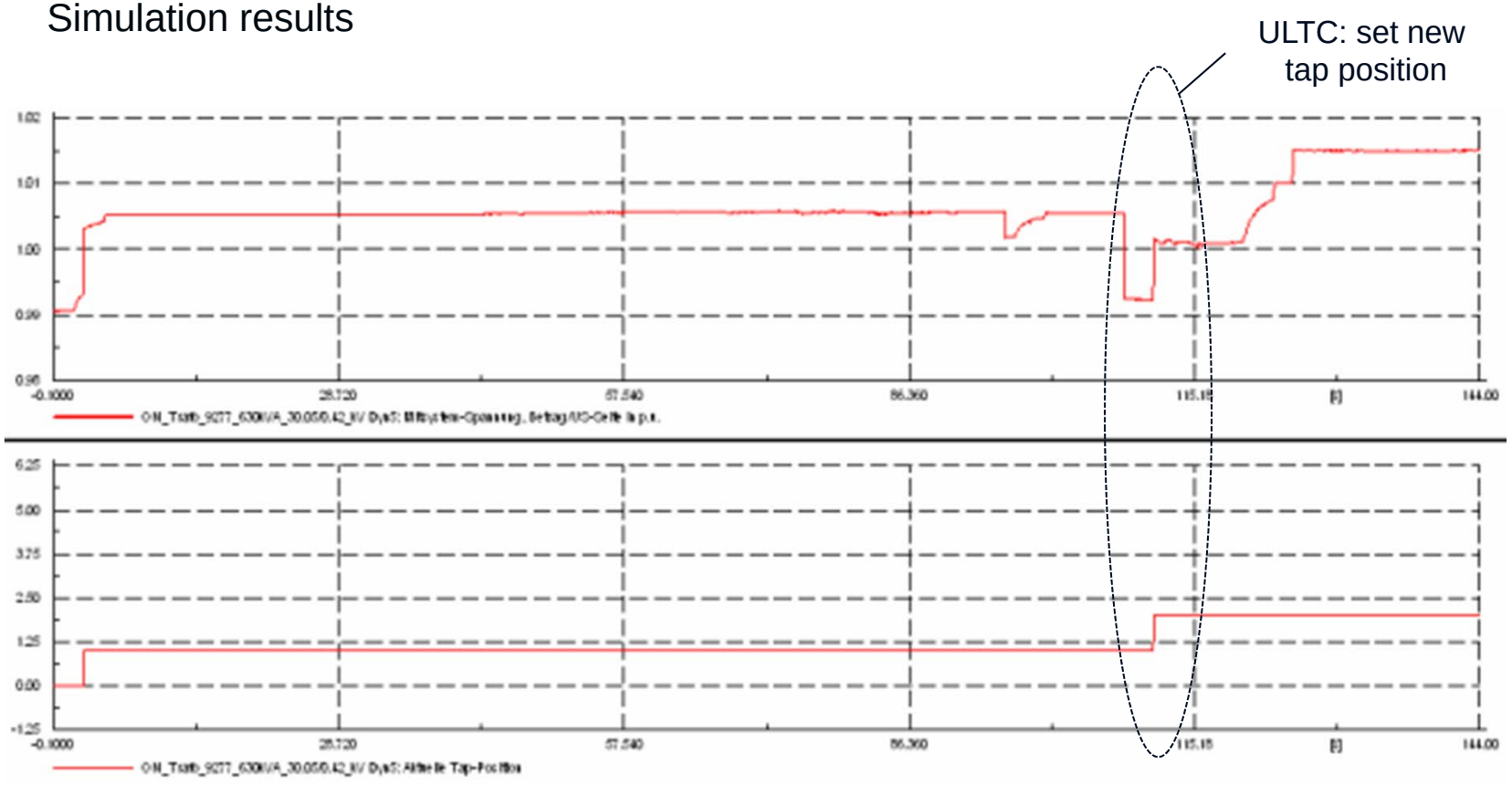


- Only usage of the 4DIAC standard function block library (no additional FB was implemented)
- Communication via Client/Server SIFBs

Co-Simulation of Electrical Grids and ICT in Lectures

Control Simulation with 4DIAC

- Simulation results



Co-Simulation of Electrical Grids and ICT in Lectures

Control Simulation with 4DIAC

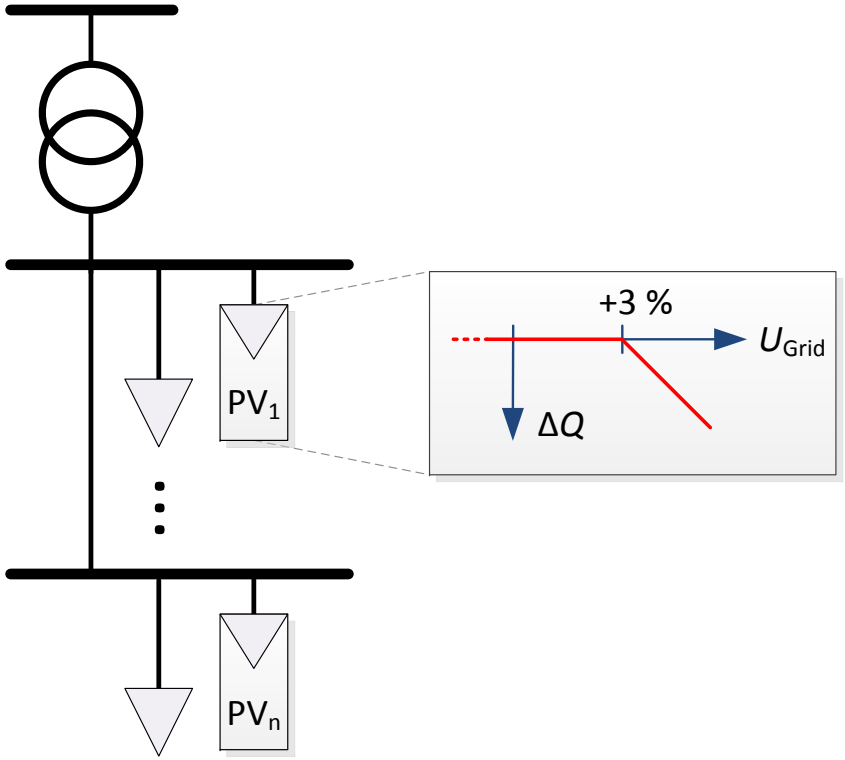
- Lessons learned (4DIAC)
  - Good engineering tool (4DIAC-IDE) and very stable runtime (FORTE) available
  - Existing 4DIAC function block library was a great help for the implementation of the ULTC algorithm
  - Monitoring feature was a great help during the implementation and improvement of the ULTC algorithm
  - Usability of 4DIAC-IDE should be improved
    - Library handling
    - Copying of whole projects or project parts
    - Sub-application handling
    - Extensions of the documentation

→ 4DIAC is an appropriate environment for the modeling of control algorithms

Reconfigurable Control Software for Smart Grids

Reconfiguration with 4DIAC

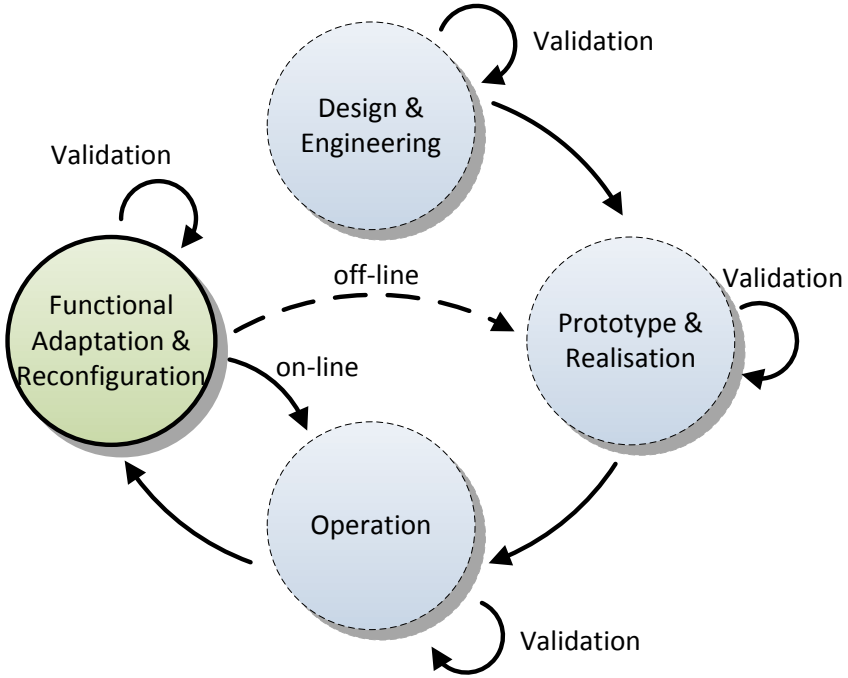
- Introduction example
  - Today its impossible to address all future (ICT) requirements in Smart Grid applications (e.g., distribution automation, demand side management)
  - Necessity to maintain control software in ICT devices for Smart Grids during operation



Reconfigurable Control Software for Smart Grids

Reconfiguration with 4DIAC

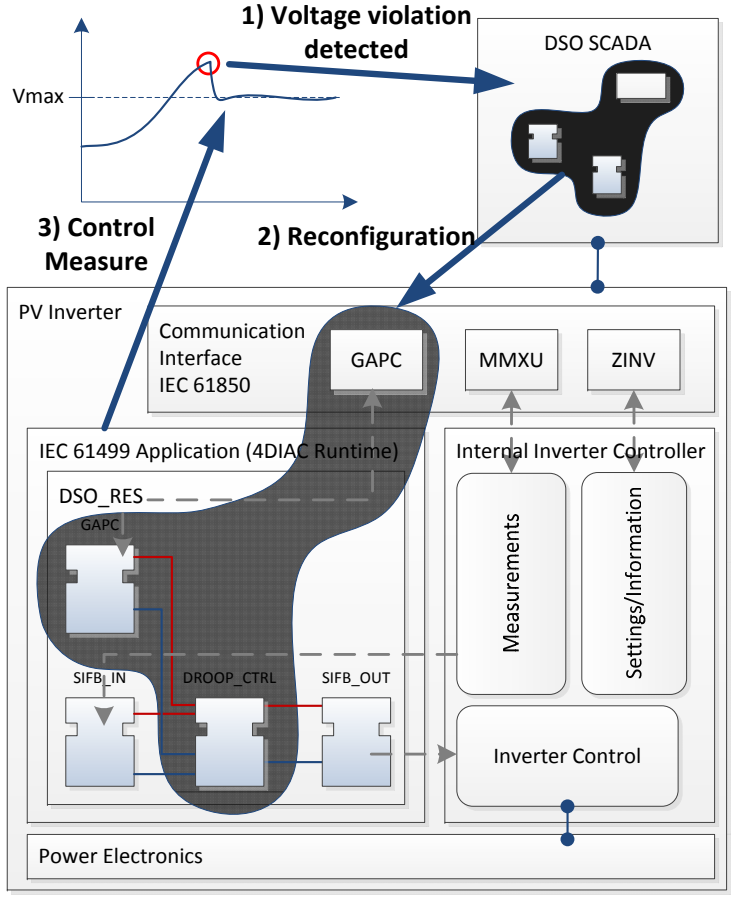
- Goals
  - Provision of an ICT-based life-cycle support for power utility automation systems
  - Based on IEC 61850/IEC 61499



Reconfigurable Control Software for Smart Grids

Reconfiguration with 4DIAC

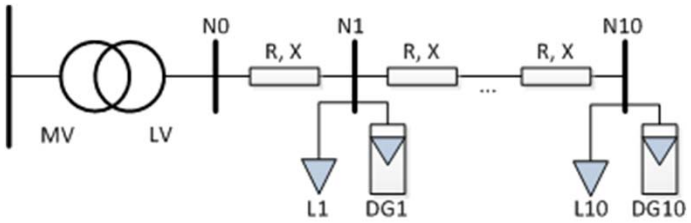
- Concept and architecture
  - IEC 61850 communication interface
  - IEC 61499 implementation of control algorithms
  - Usage of IEC 61850 and IEC 61499 configuration interfaces for on-line update/adaptation of control functions



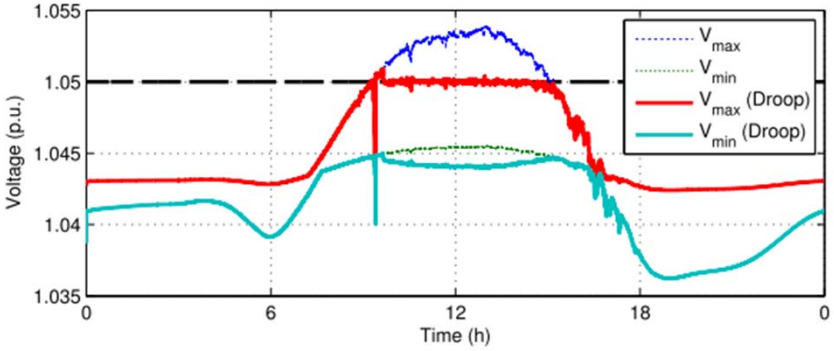
Reconfigurable Control Software for Smart Grids

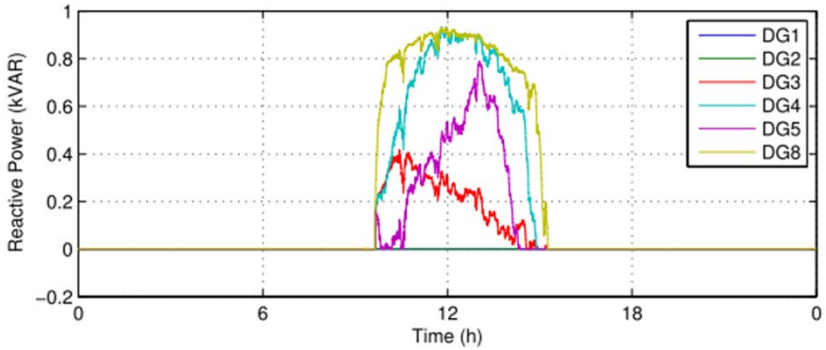
Reconfiguration with 4DIAC

- Simulation results with 4DIAC and PowerFactory
  - Simple test network



  - Results (voltages) at node DG5





Summary and Future Activities

Plans for the upcoming months

- 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
- Development of an IEC 61499 Compliance Profile for Smart Grids and implementation of it in 4DIAC
- Enhancement of the proposed IEC 61850/IEC 61499 reconfiguration support for Smart Grid applications

ACKNOWLEDGEMENTS: This work is funded by the Austrian Climate and Energy Fund with the support of the Austrian Research Promotion Agency (FFG) under the project “DG-EV-HIL”.

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