Munich Institute of Integrated Materials,
Energy and Process Engineering (MEP)
Technische Universität München

IDP / RESEARCH INTERNSHIP

Development of OPC UA communication for integrated thermal-electric energy system control in CoSES Lab

Motivation and Background

The CoSES Research Laboratory at TU Munich is an experimental microgrid that integrates electrical, thermal, and communication networks. It employs advanced thermal-electric sector coupling techniques, using different optimizer tools, that determine the allocation of energy across different resources. Depending on a forecast, energy pricing information, and measurement data from the laboratory, the optimizer calculates temperature and power set points for the next timestep for each of the energy resources in the network under investigation. A critical component of this approach is the communication between the optimizer and the LabVIEW/VeriStand framework, responsible for controlling the physical hardware. Therefore, this work focuses on developing an OPC UA interface between the lab control framework and external management software. To enhance compatibility, a standardized interface based on an OPC UA custom information model shall be developed and implemented. This will improve the lab's capability to manage and test thermal and electrical energy coupling in real-time experiments. The overall communication structure of the laboratory is shown in the figure below, where the interface to be developed is shown in blue.

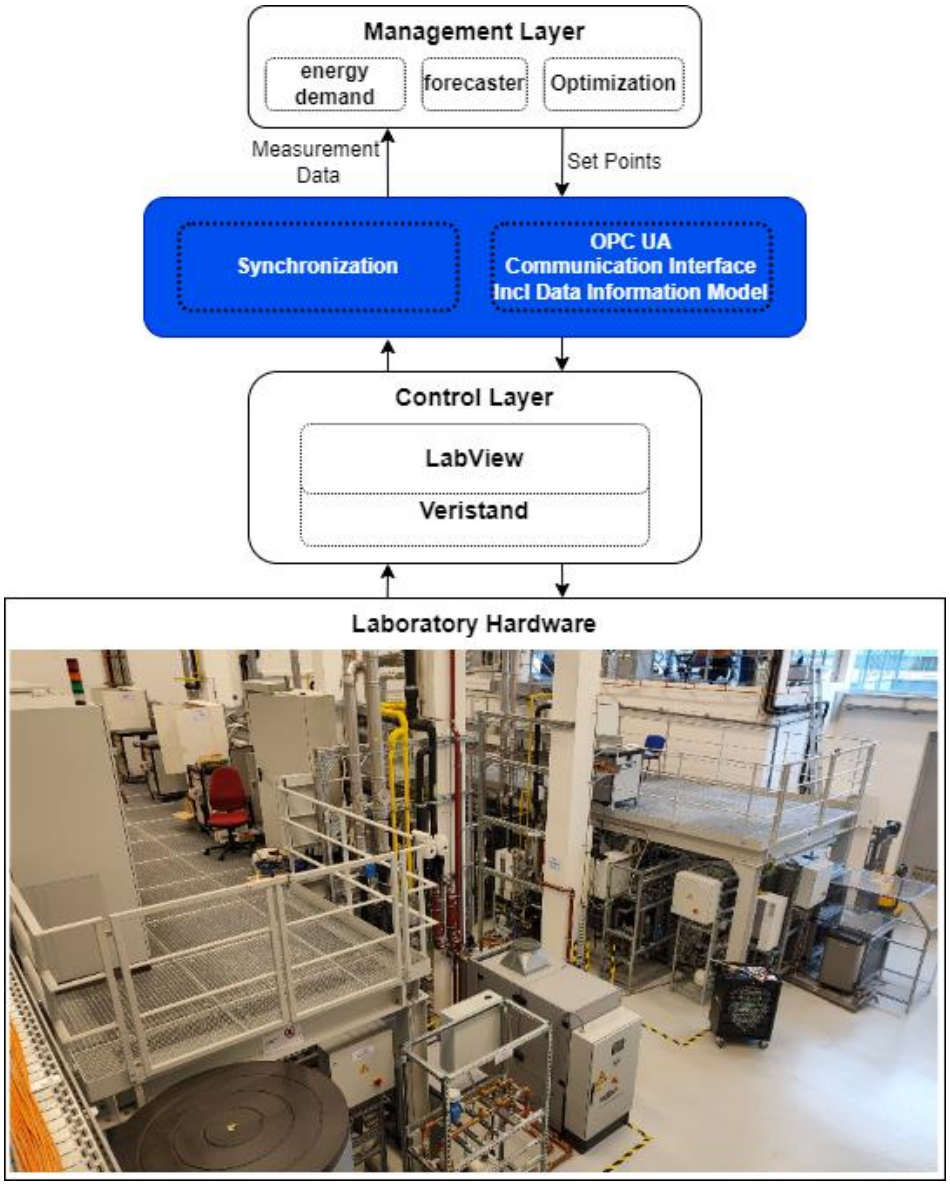

Figure 1: Laboratory Communication Structure

Tasks and Milestones

The objective of the thesis is to create an interface between external management software and the LabVIEW/VeriStand control layer using a standardized OPC UA custom information model. The following tasks and milestones are proposed:

1. Study the OPC UA standard and its application in industrial communication
2. Do a requirement analysis for the interface to be developed and allocate methods to fulfill the requirements using the OPC UA standard
3. Develop an appropriate data information model for the application based on data point specifications given by the research group
4. Establish the OPC UA interface, by programming the necessary server-client structure in LabVIEW to send / receive data to/from the optimizer on the management level
5. Automatize the setup of the counterpart interface at the optimizer by using .xml or .json files to replicate the structure
6. (Optionally) Develop a synchronization tool to coordinate when which data points are sent / received during online operation
7. Validate the functionality of the developed software artifacts by a minimal test run comprising all components at the same time
8. Process and work product documentation for each of the steps mentioned above

Requirements

- Understanding of network protocols, IP addressing, data transmission techniques, data modeling, specifically for OPC UA
- Basic knowledge of Energy Systems desirable
- Experience in LabVIEW and NI VeriStand platforms (optional)
- Strong problem-solving skills and the ability to work independently in a structured manner

Application

If you are interested in working on this or a related topic, please contact Thomas Lickleder or Anurag Mohapatra and state your motivation as well as your relevant prior knowledge and qualifications.

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