

## **Bachelor/Master-Thesis:**

### Implementation and interoperability analysis of a distribution system automation in real time application

#### **Context:**

An interoperability testing suite is worked out during the course of this thesis. Initially, the student is provided with some literature regarding the Smart Grid Architecture Model (SGAM), statistical design and analysis of the experiments, LV and MV European reference grids, etc. The objective of this thesis is to work out technical solutions and recommendations to tackle the existing difficulties to ensure interoperability among different components/actors of smart grids. For this purpose, a hardware-in-the-loop (HIL) setup is expected to be set which includes the monitoring Supervisory Control and Data Acquisition (SCADA), real-time simulation, and the communication network among different actors/controller. In Figures 1 and 2, you can see an exemplary scenario for a monitoring system and the respective HIL setup, respectively. In Figure 3, the integrated methodology which will be followed for interoperability testing is sketched.

#### **Your tasks:**

- Modelling of different grid and monitoring components (SCADA, Remote Terminal Unit (RTU), aggregator, distributed energy resources) including the grid model itself [2] which will be provided for the student
- Setting up the test bench including communication network emulator, Hardware-in-the-loop (OPAL-RT)
- Design and analysis of the experiments based on the JRC methodology [1].
- Setting up the selected set of actors and components in the laboratory and conducting tests.
- Implementation of the whole test set-up under different exemplary validation scenarios, e.g., voltage support, congestion management, etc.
- Post-processing of the results (sensitivity analysis, metamodeling, interoperability, etc.)

#### **Your profile:**

- Student of electrical engineering or information technology preferably from RWTH Aachen University.
- Experience with modelling and simulation

- Basic knowledge about electrical distribution systems and statistics.
- Willing to learn and test communication network for distribution grid automation
- Interest in learning advanced statistical methods for interoperability testing and experimental design.
- Working capability in autonomy and in a proactive way.

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**Figures:**

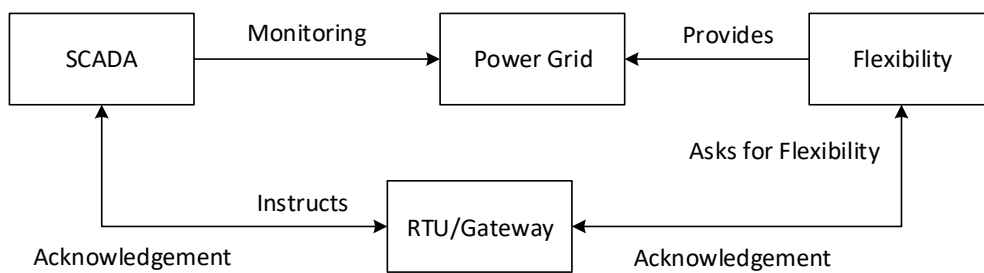


Figure 1 Exemplary architecture for a monitoring system

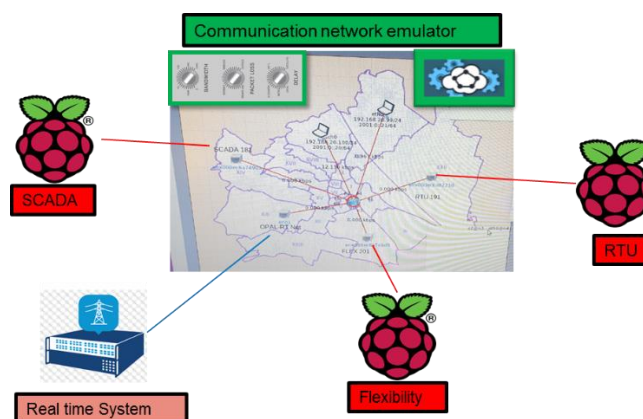


Figure 2 Schematic representation of the HIL test bench including communication network emulator

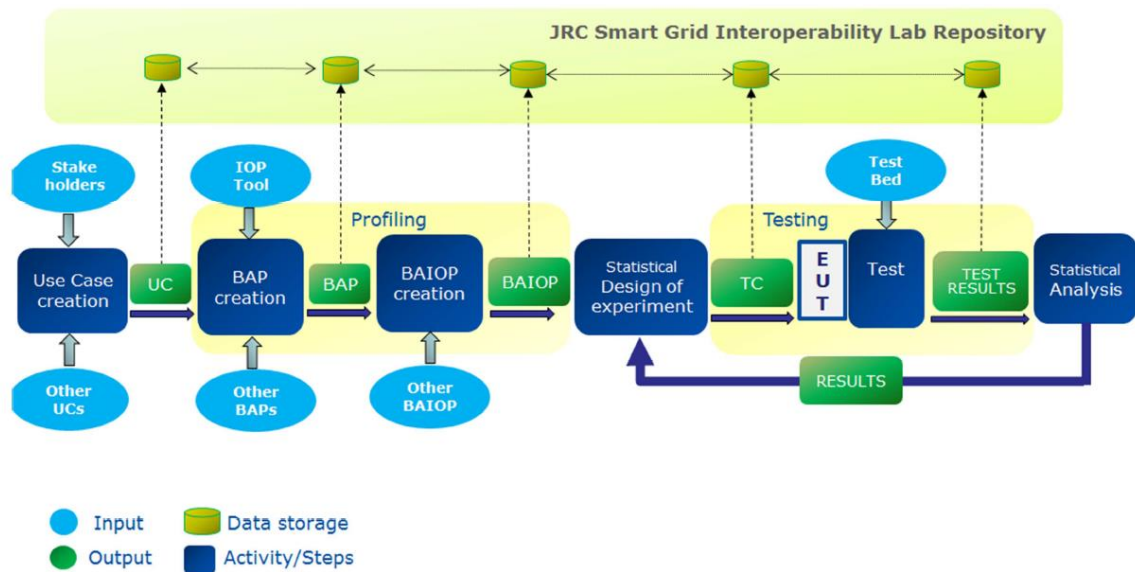


Figure 3 Schematics of the JRC Interoperability Testing Methodology

### References:

- [1] Papaioannou I., Tarantola S., Lucas A., Kotsakis E., Marinopoulos A., Ginocchi M., Masera M., *Smart grid interoperability testing methodology*, EUR 29416 EN, Publications Office of the European Union, Luxembourg, 2018, ISBN 978-92-79-96855-6, doi:10.2760/08049, JRC110455
- [2] Benchmark Systems for Network Integration of Renewable and Distributed Energy Resources, Task Force C6.04.02