



Smart TSO-DSO interaction schemes, market architectures and ICT
Solutions for the integration of ancillary services from demand side
management and distributed generation

EP3 | The results of the SmartNet project

Results for the Hardware-in-the-Loop Activities

Filip Pröbstl Andrén
AIT Austrian Institute of Technology

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Agenda

- Introduction and motivation
- AIT SmartEST lab
- Selected test cases
- Conclusions

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Introduction and Motivation

- SmartNet compares five different TSO-DSO coordination schemes
- Validation of the TSO-DSO coordination schemes
 - Three demonstration projects (pilots)
 - Laboratory tests
- Extended validation possibilities using laboratory tests
 - Test future scenarios beyond the current regulatory framework
 - Anticipate potential issues before implemented in a real scenario

Introduction and Motivation

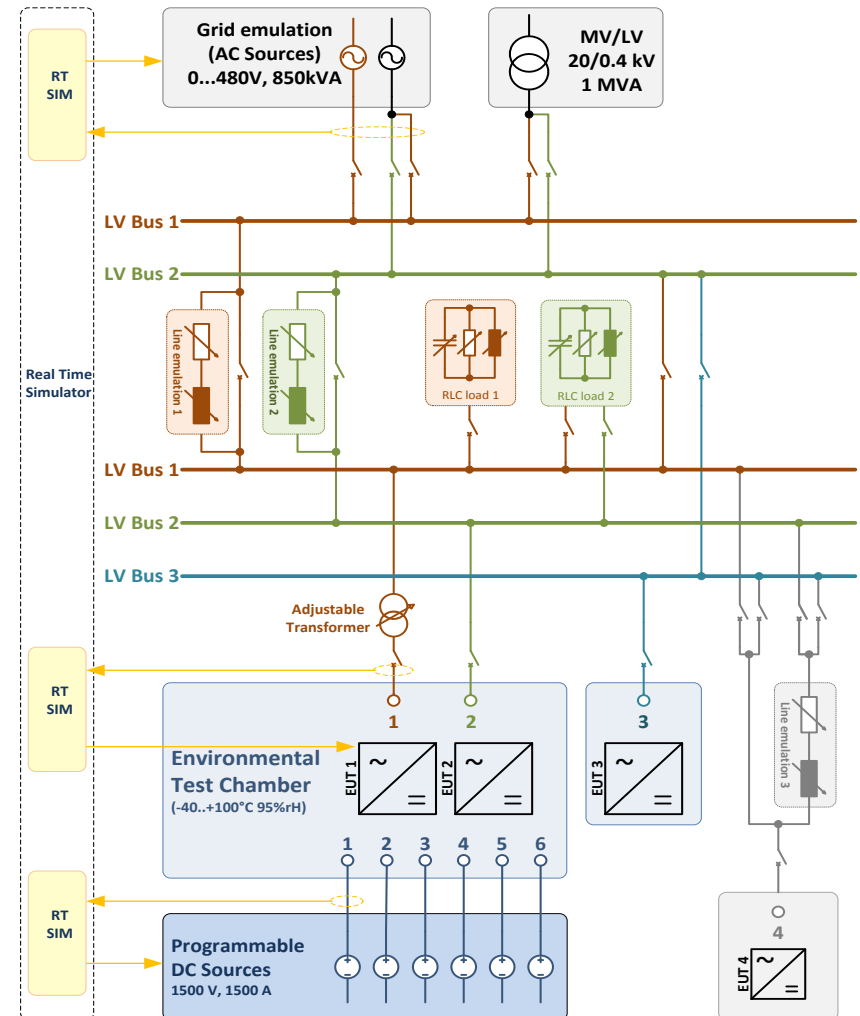
- Goals for the laboratory tests
 - Analyze interactions between equipment and provide suggestions for the pilots
 - Obtaining a validated simulation environment (also real-time aspects)
 - Validation using additional hardware components, not directly covered in the pilots
 - Analyzation of additional communication aspects, such as latency or packet drops

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Overview of the 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



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Selected Test Cases

- Three test cases (TC) were selected
 - TC1: Validation of DMS and PPC used in the Italian Pilot
 - TC2: Validating the Impact of ICT on the Italian Scenario
 - TC3: Price-Based Controls in Combination with SmartNet Coordination Schemes

Selected Test Cases

- **TC1: Validation of DMS and PPC used in the Italian Pilot**
- TC2: Validating the Impact of ICT on the Italian Scenario
- TC3: Price Based Controls in Combination with SmartNet Coordination Schemes

Italian Pilot Overview

In the involved distribution network, substations and generation units have been selected in order to have a complete system to test several functionalities with different devices to guarantee interoperability using the standard protocol IEC61850.



The equipment to be installed on the EDYNA MV network is provided from the manufacturer SELTA.

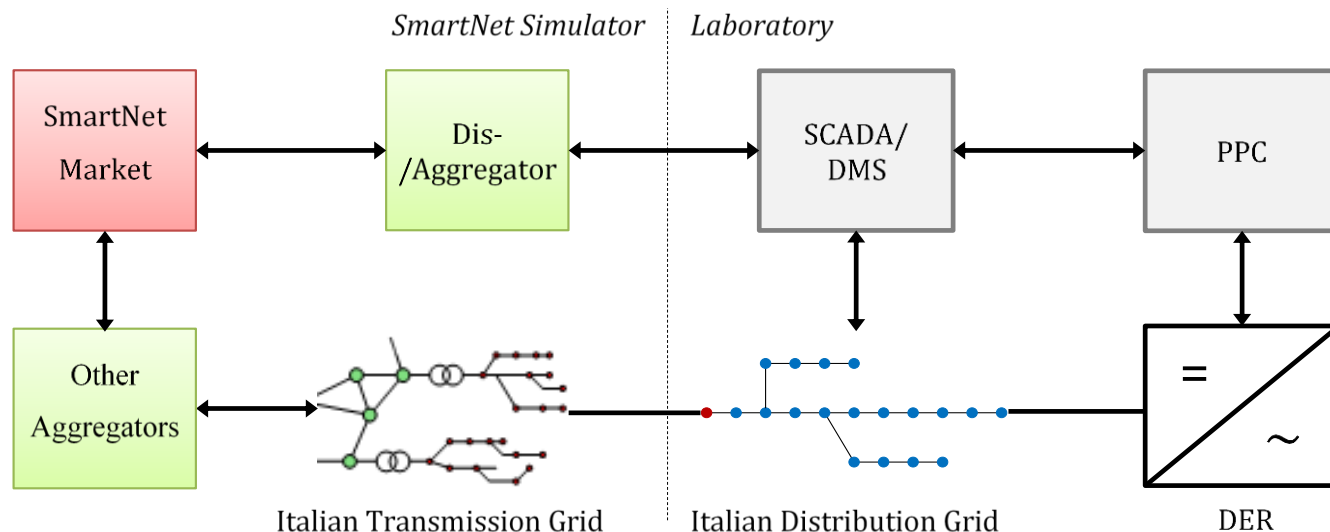
Valley of Ahrntal, in South-Tyrol, Italy

Molini di Tures Primary Substation

**1 HV hydraulic generation and many MV generators
(Hydro, thermo and PV)**

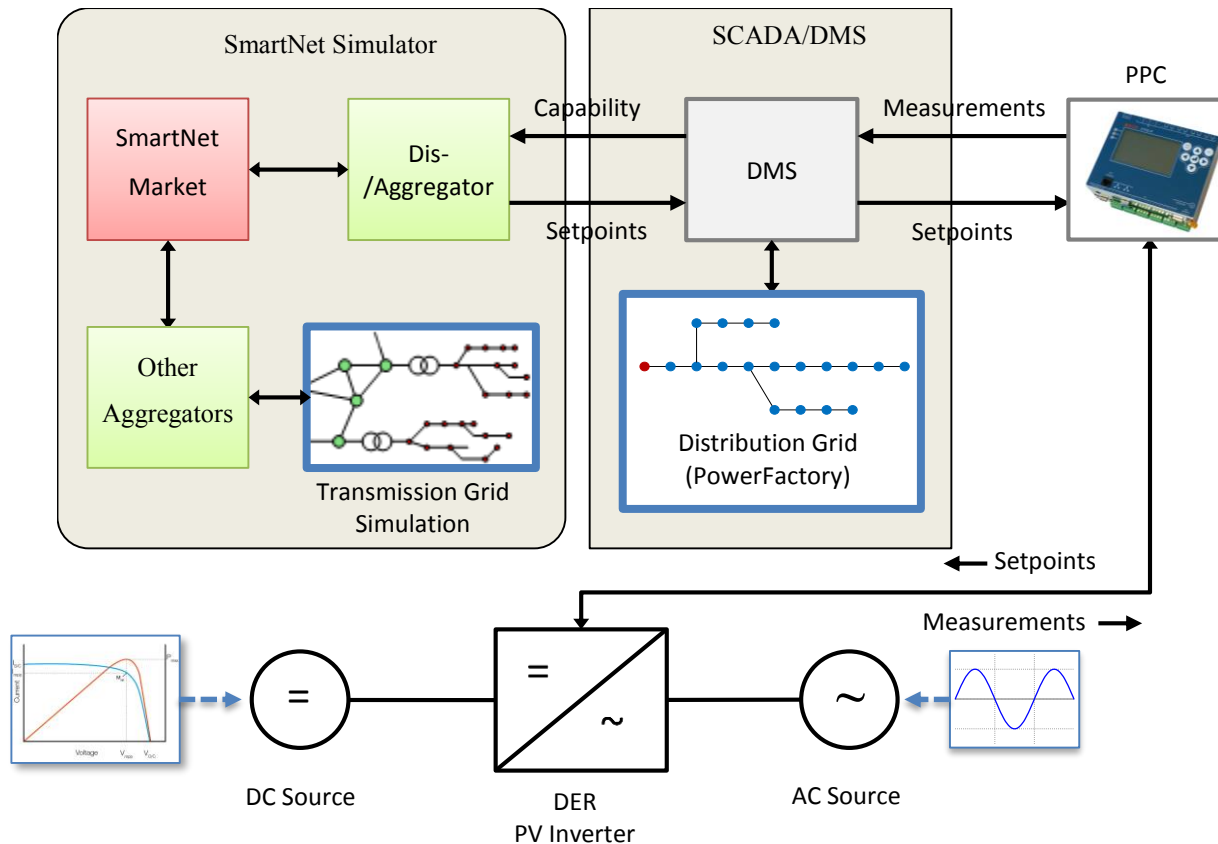
TC1: Validation of DMS and PPC used in the Italian Pilot

- Scenario is based on the Italian Pilot
 - Further testing of the functionality of the DMS and the Power Plant Controller (PPC) with a HIL simulation

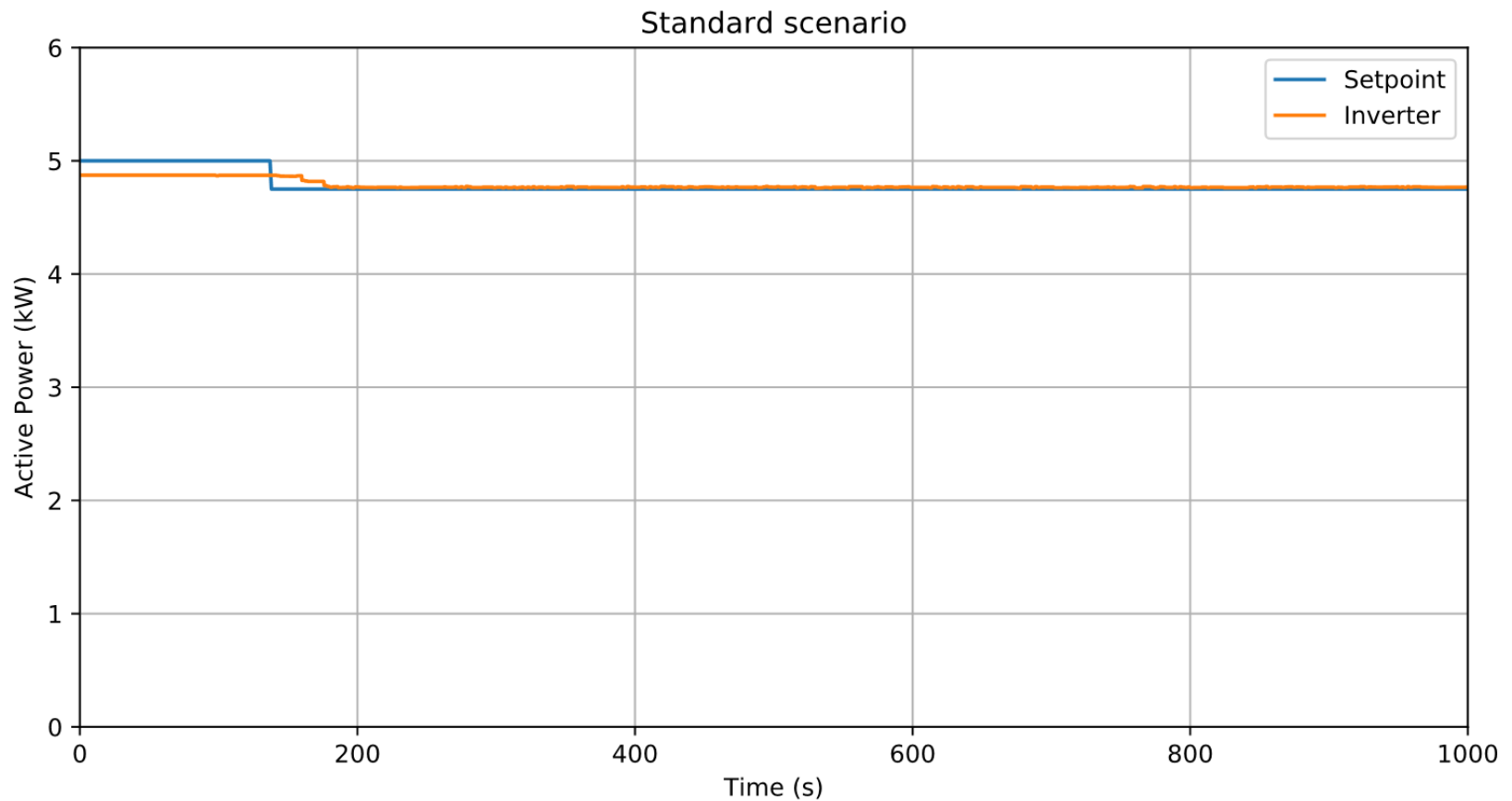


TC1: Validation of DMS and PPC used in the Italian Pilot

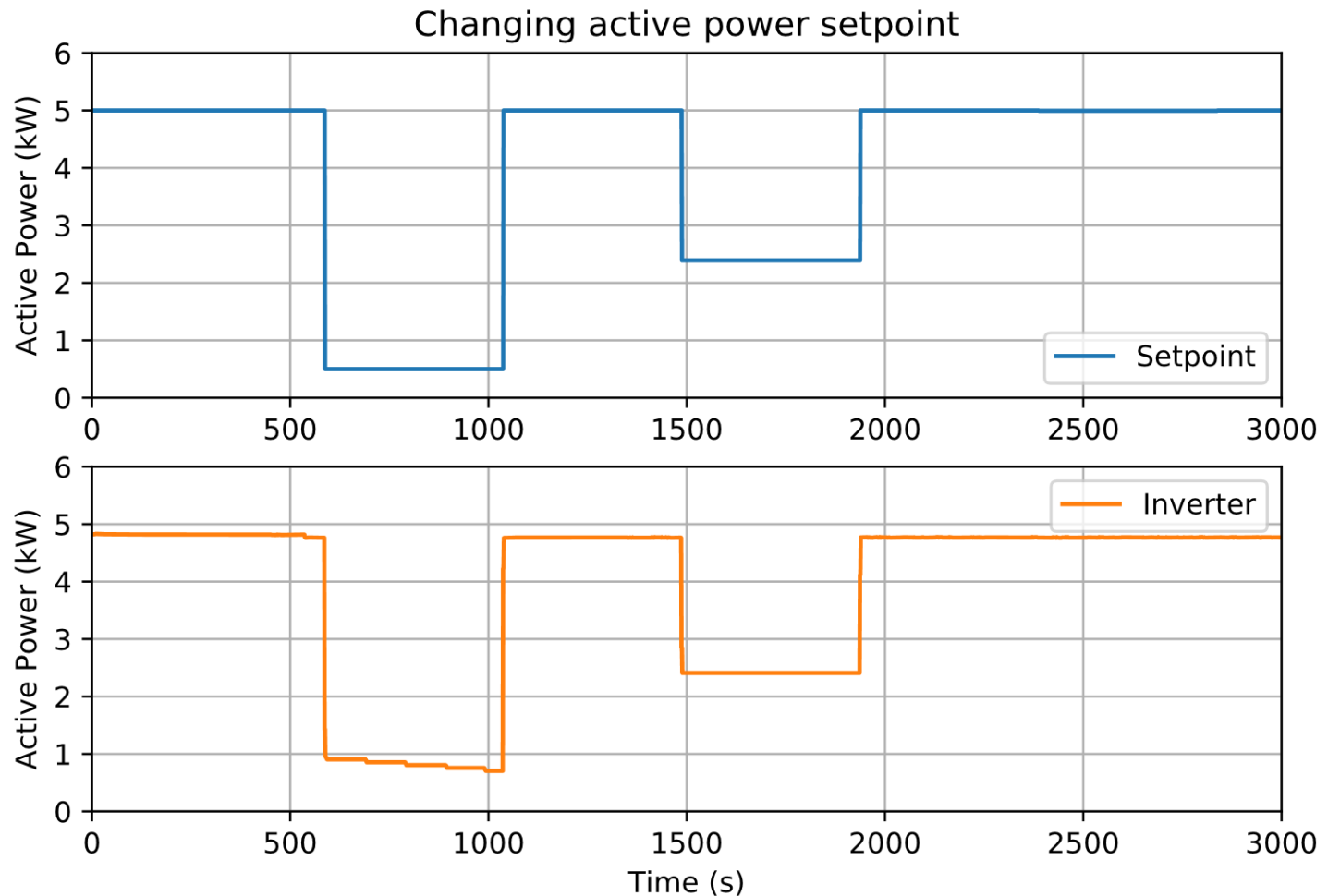
■ Test case setup



TC1: Validation of DMS and PPC used in the Italian Pilot



TC1: Validation of DMS and PPC used in the Italian Pilot

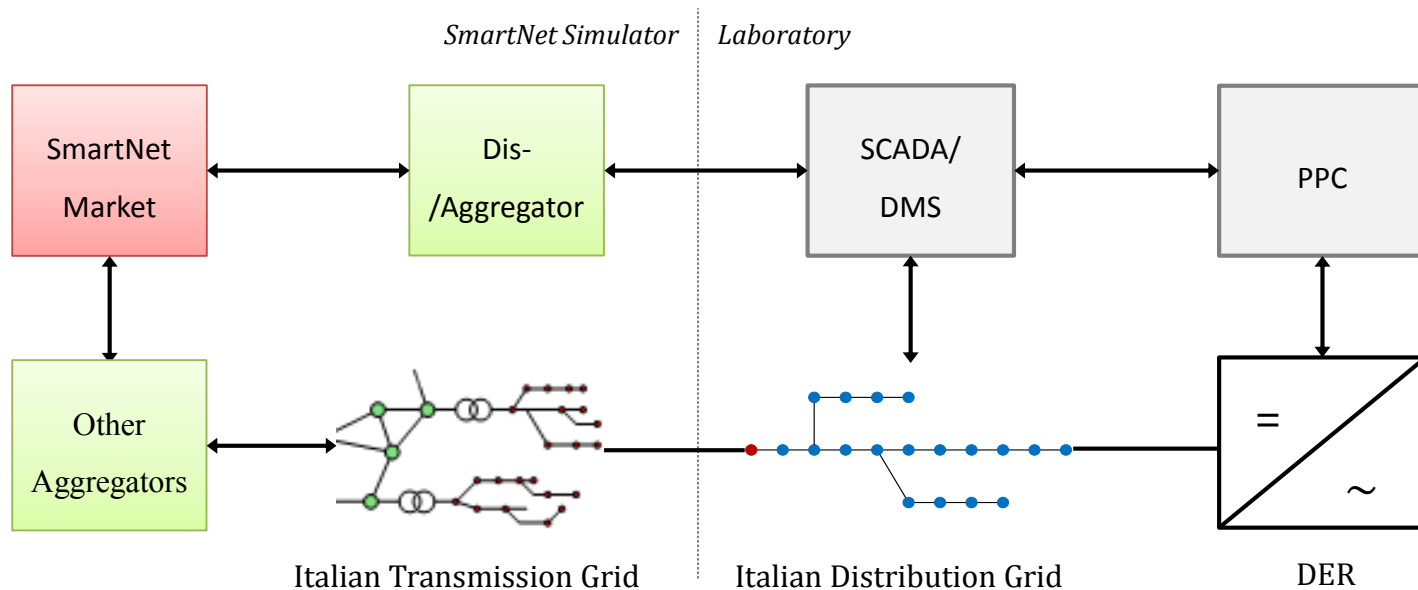


Selected Test Cases

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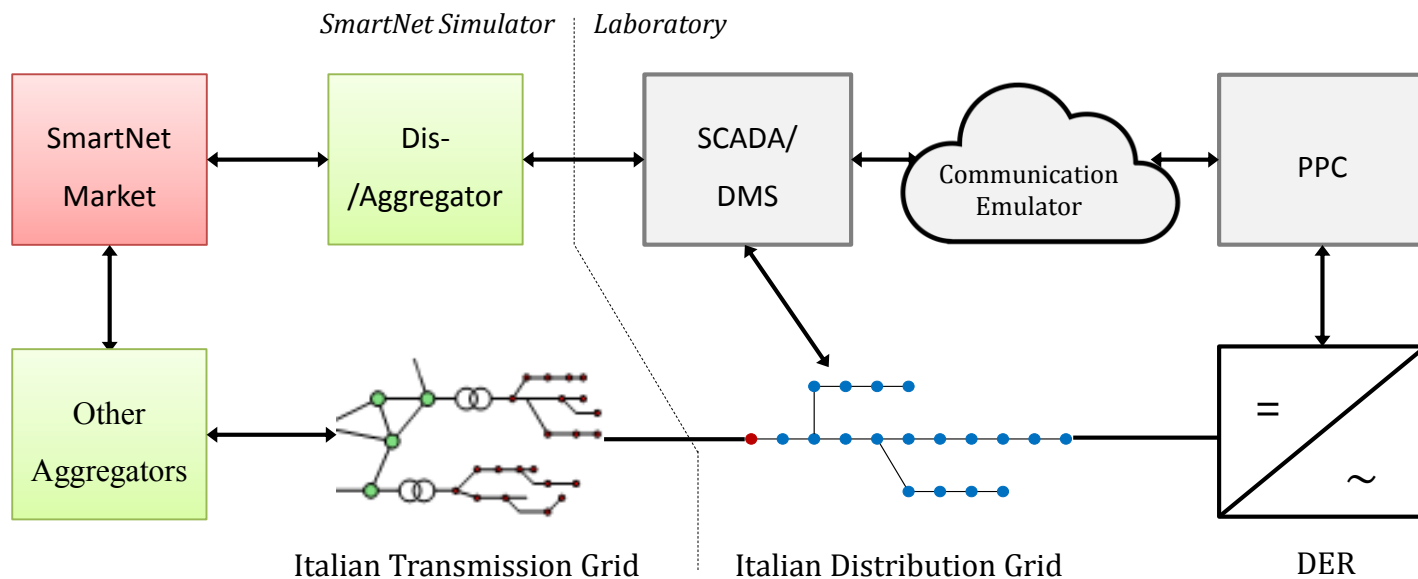
TC2: Validating the Impact of ICT on the Italian Scenario

- Extension of TC1



TC2: Validating the Impact of ICT on the Italian Scenario

- Extension of TC₁
 - Emulate the communication between SCADA/DMS and PPC

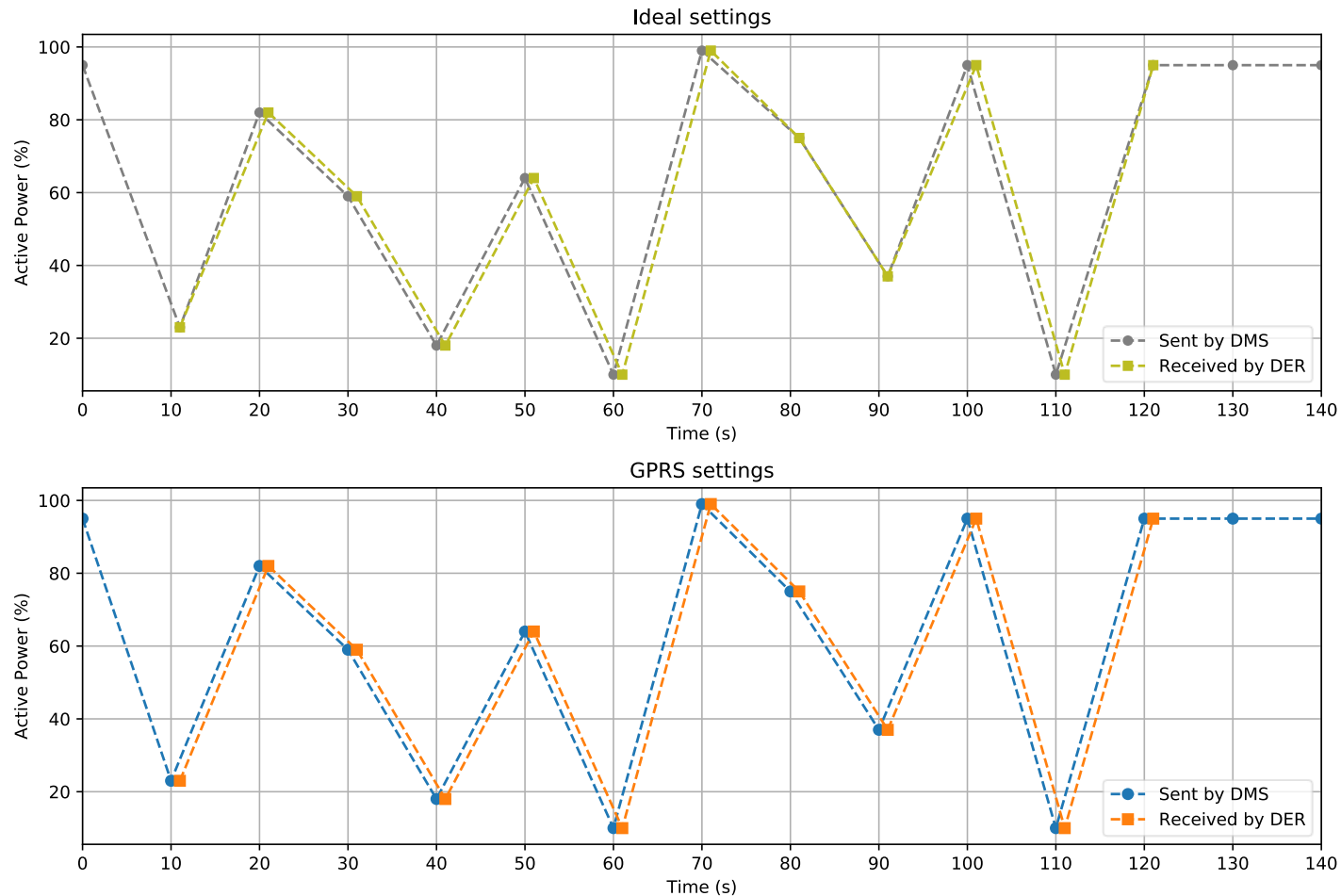


TC2: Validating the Impact of ICT on the Italian Scenario

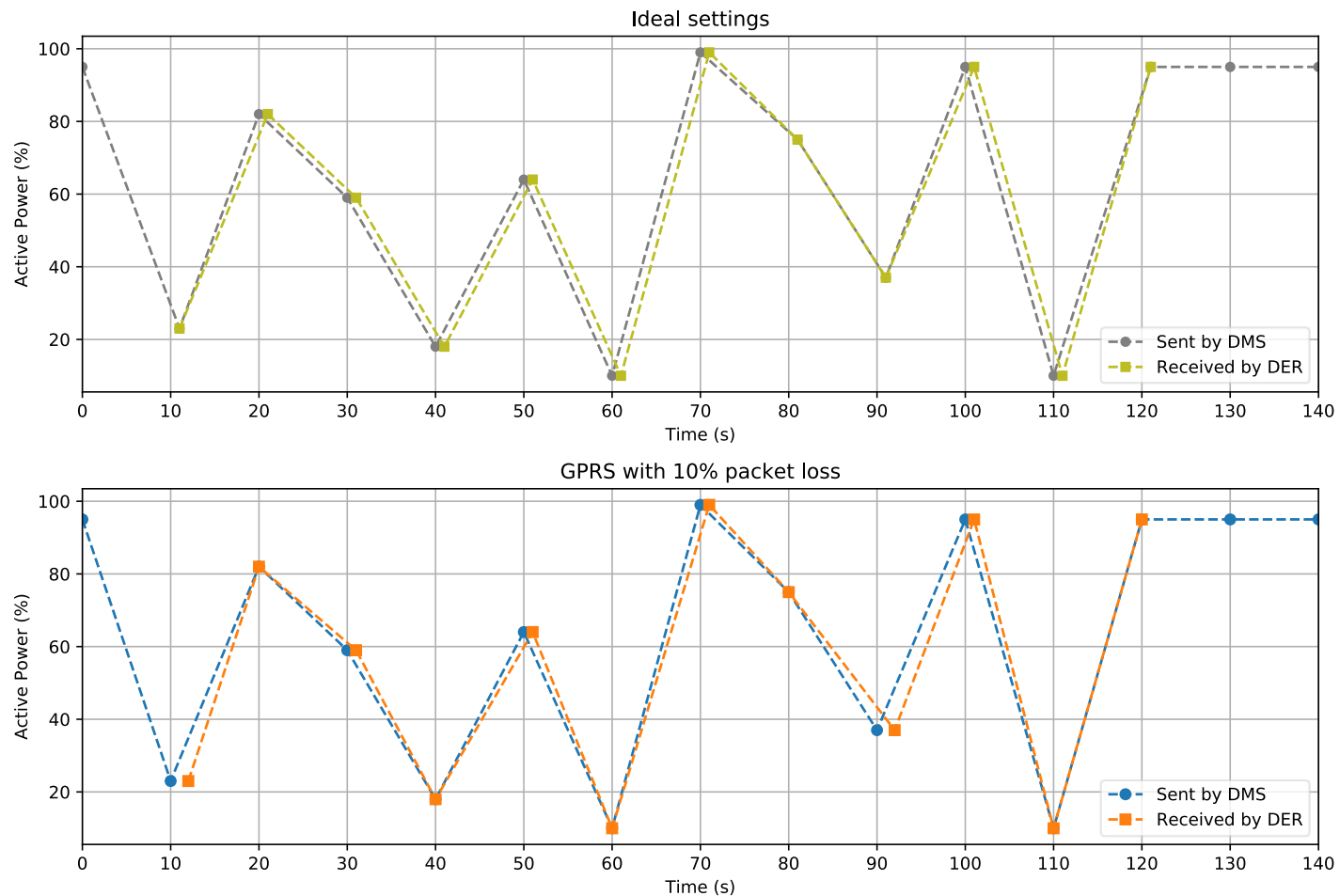
- Communication emulator
 - Two main parts
 - Back-end for the control of the emulation
 - Front-end GUI for user configuration
 - Different configurations can be used for different communication flows
 - Profiles are defined with settings for delay, loss, corruption, etc.
 - Approximately 1000 different flows can be emulated simultaneously



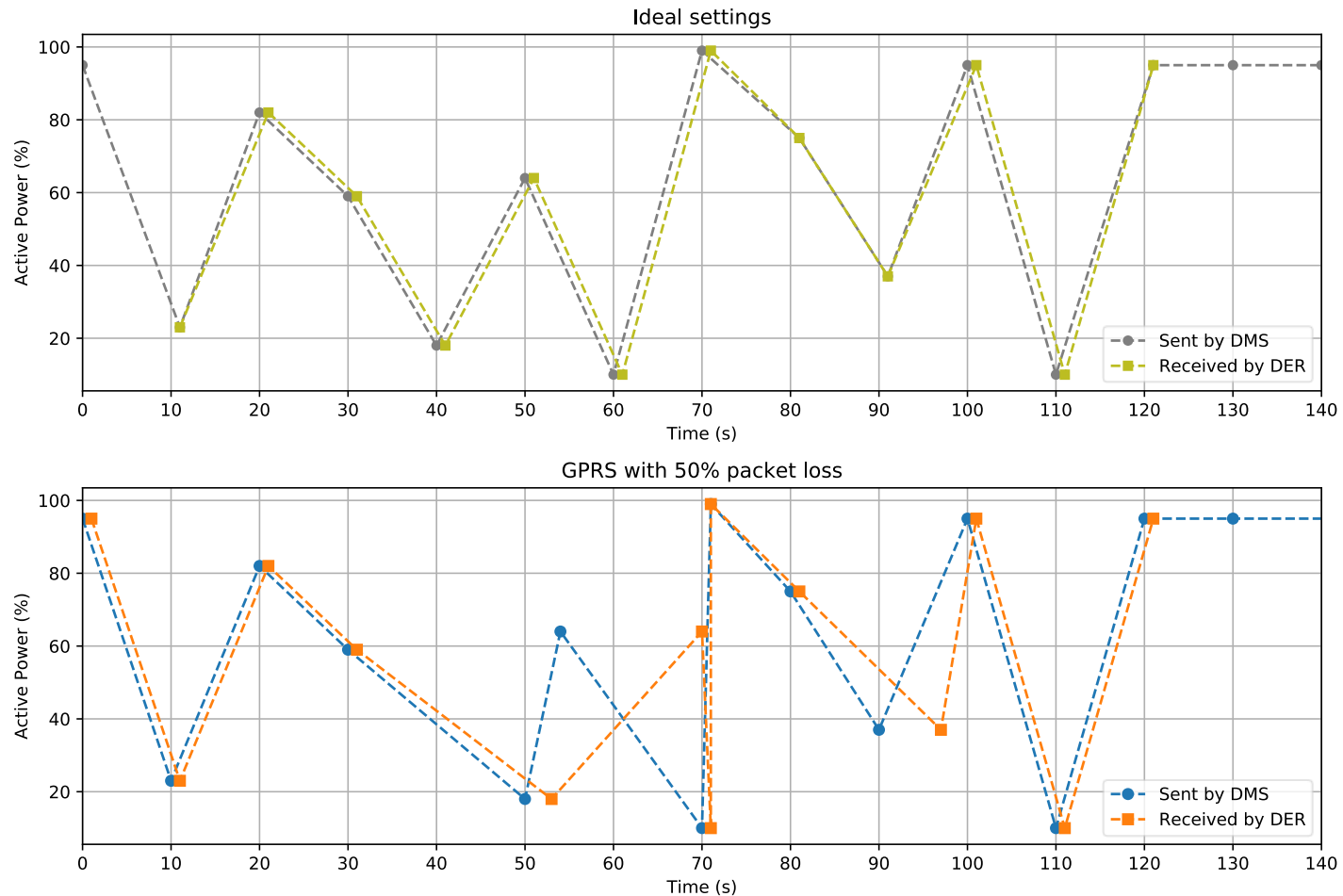
TC2: Validating the Impact of ICT on the Italian Scenario



TC2: Validating the Impact of ICT on the Italian Scenario



TC2: Validating the Impact of ICT on the Italian Scenario

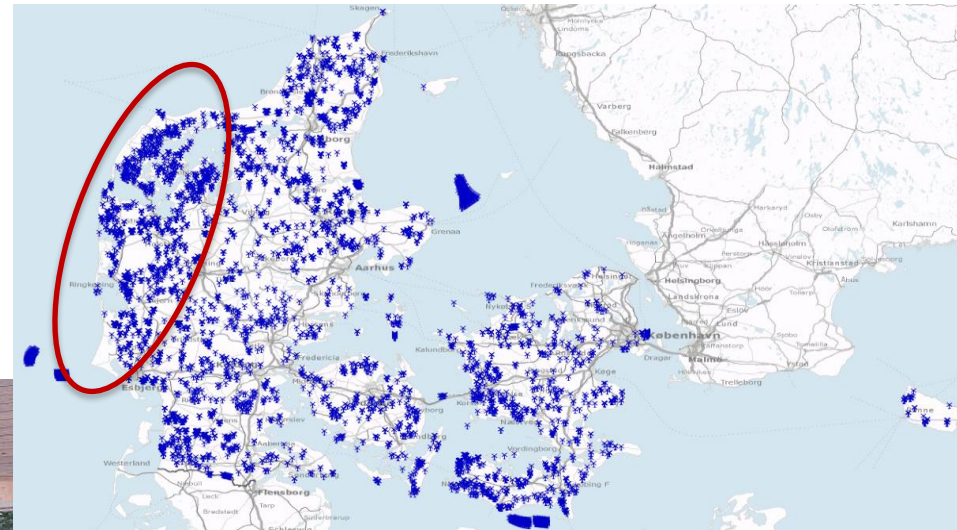


Selected Test Cases

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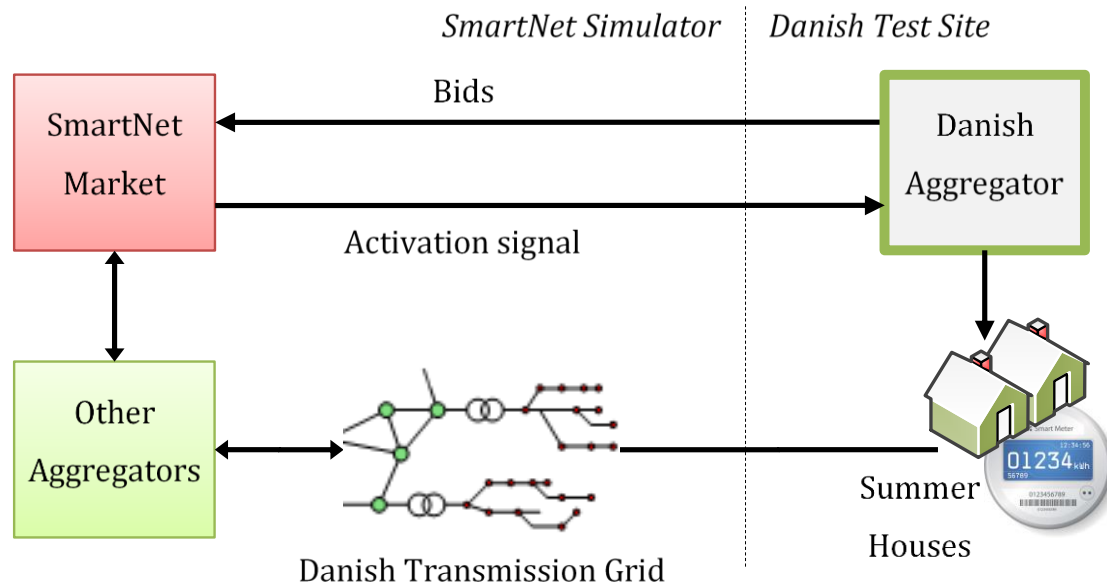
Danish Pilot Overview

- 30 summer houses
- Electric heated swimming pools
- Highly flexible consumption



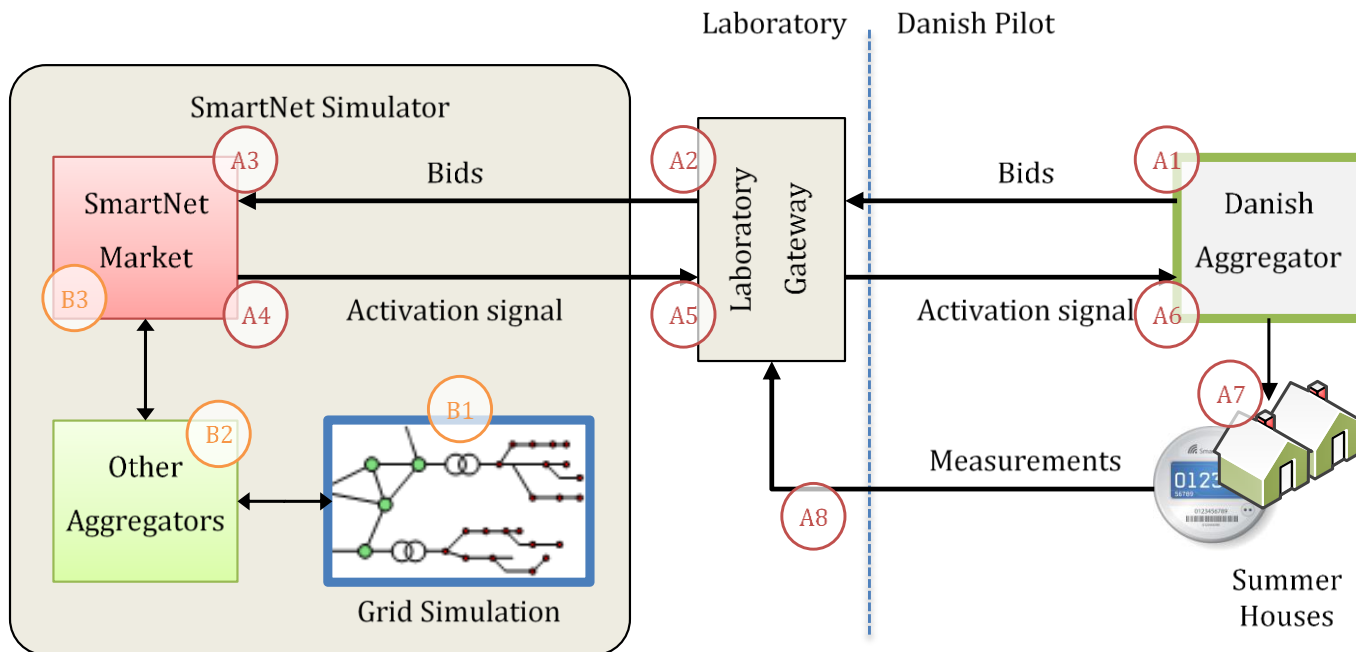
TC3: Price Based Controls in Combination with SmartNet Coordination Schemes

- Based on the Danish Pilot
 - Integrate the summer houses and their aggregations as components into a market simulation



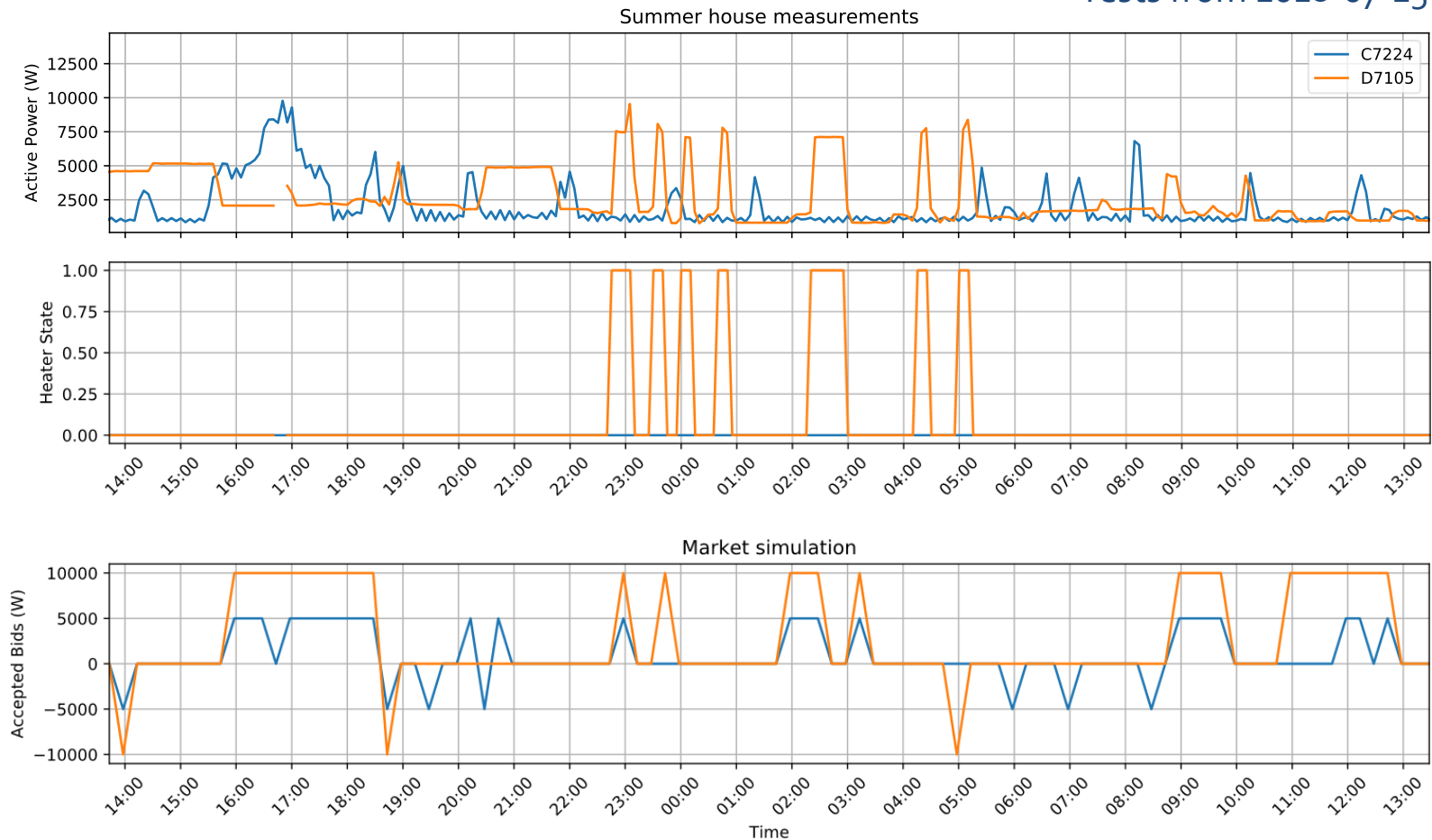
TC3: Price Based Controls in Combination with SmartNet Coordination Schemes

■ Test case setup



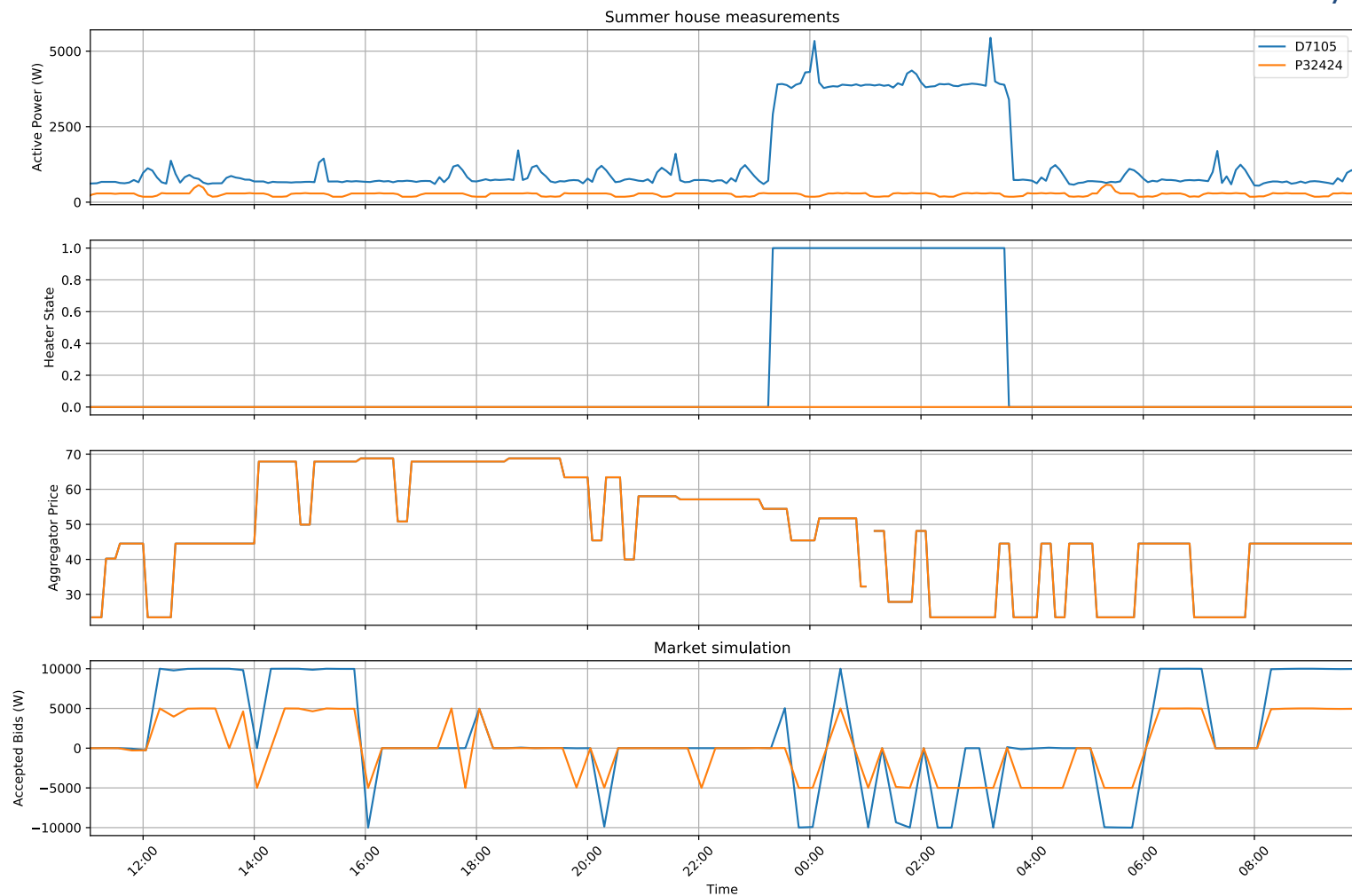
TC3: Price Based Controls in Combination with SmartNet Coordination Schemes

Tests from 2018-07-25



TC3: Price Based Controls in Combination with SmartNet Coordination Schemes

Tests from 2018-12-17



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Conclusions

- Problems detected during integration of equipment
 - Different components than in the pilots
 - Timing between controller and DER
 - Wrong bid format used by the aggregator
- Discussion on tests results
 - Integration technically possible
 - Adaption of scenarios necessary to achieve interesting results
 - State-of-the-art ICT technologies sufficient
 - Price-based control not intended with the SmartNet simulator



Thank You

Filip Prörtl Andrén

Contact Information

Affiliation:	AIT Austrian Institute of Technology
Phone:	+43 664 235 19 16
Email:	filip.proestl-andren@ait.ac.at

SmartNet



SmartNet-Project.eu

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