Control algorithm and infrastructure for smart grid topologies

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Overview

- Introduction
- The smart distribution grid topology
- Special Control Units
- Control algorithm
- Experimental Results

Introduction

For increased penetration of renewable energy sources and energy storage technologies into the grid:

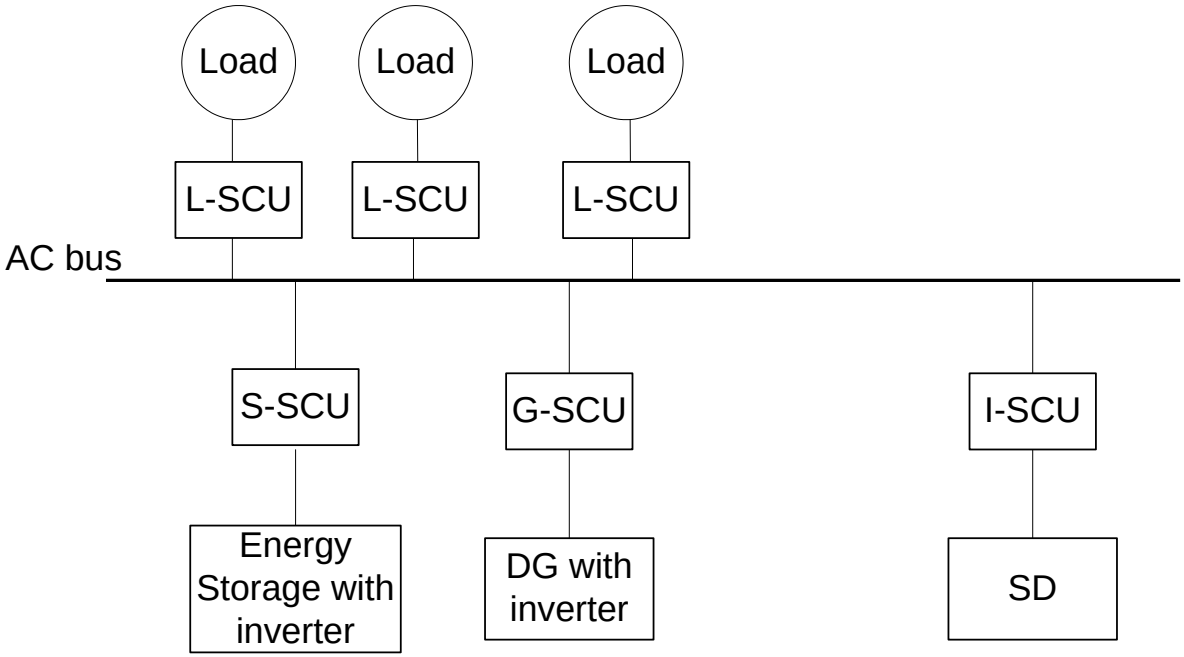
- Proper grid topology
- Respective control infrastructure.
- Control algorithm

Introduction

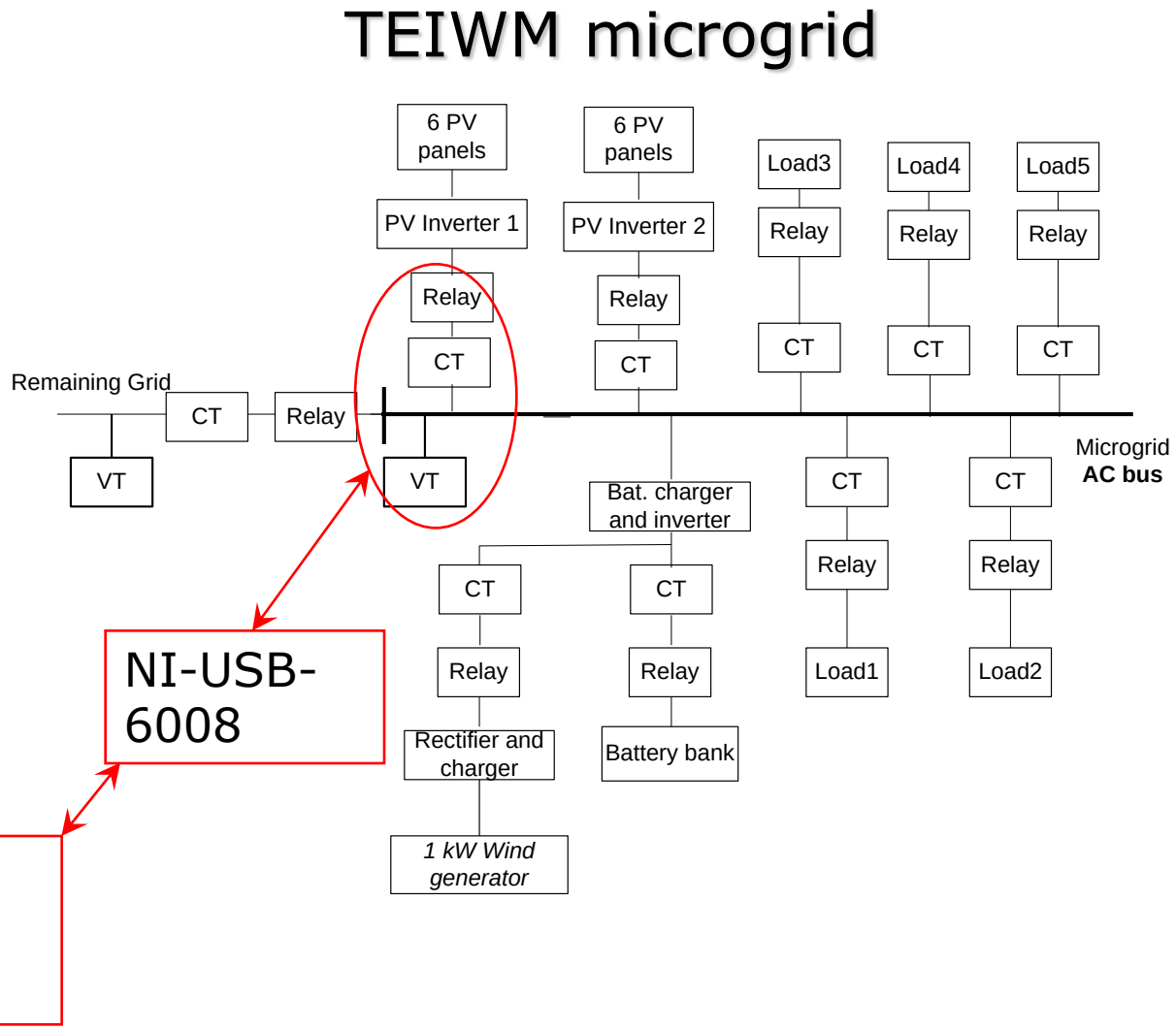
- Experimental investigation of interconnected small-scale microgrids of such topologies could facilitate the transformation from the traditional to the smart electric grid.

The smart distribution grid topology

➢ A microgrid-based smart grid topology

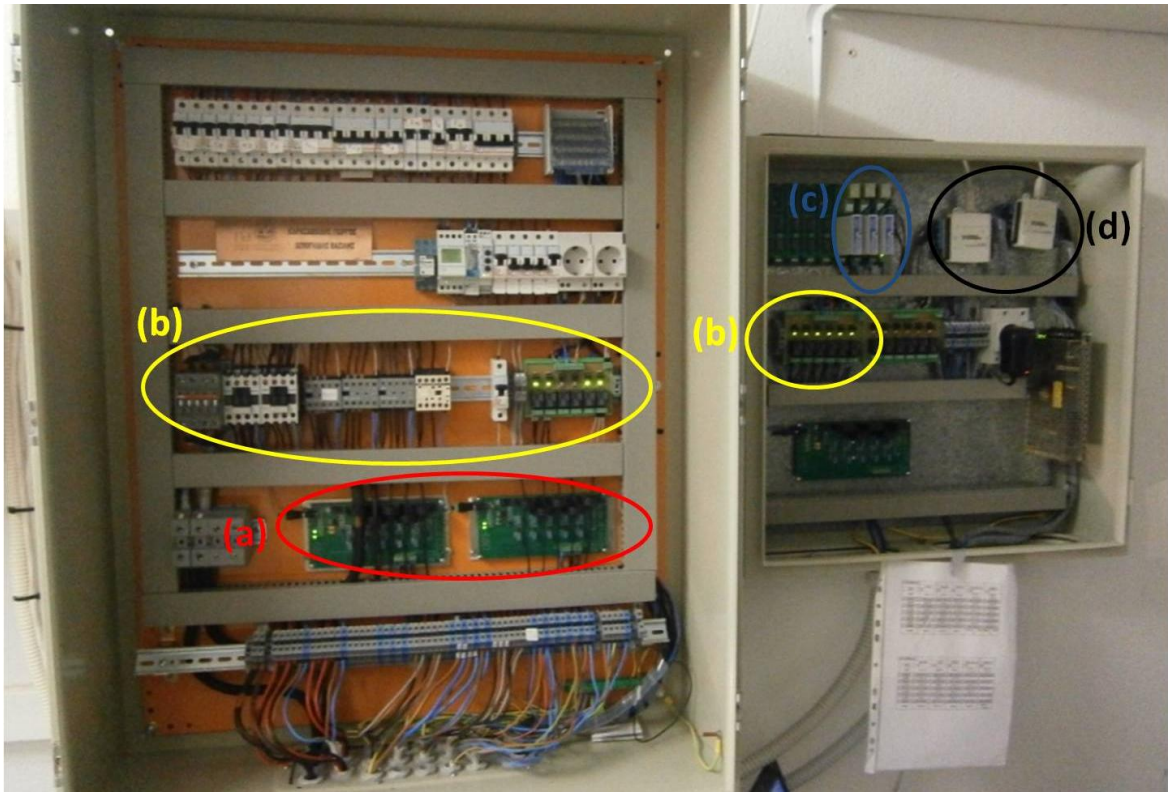


Special Control Units (SCUs)

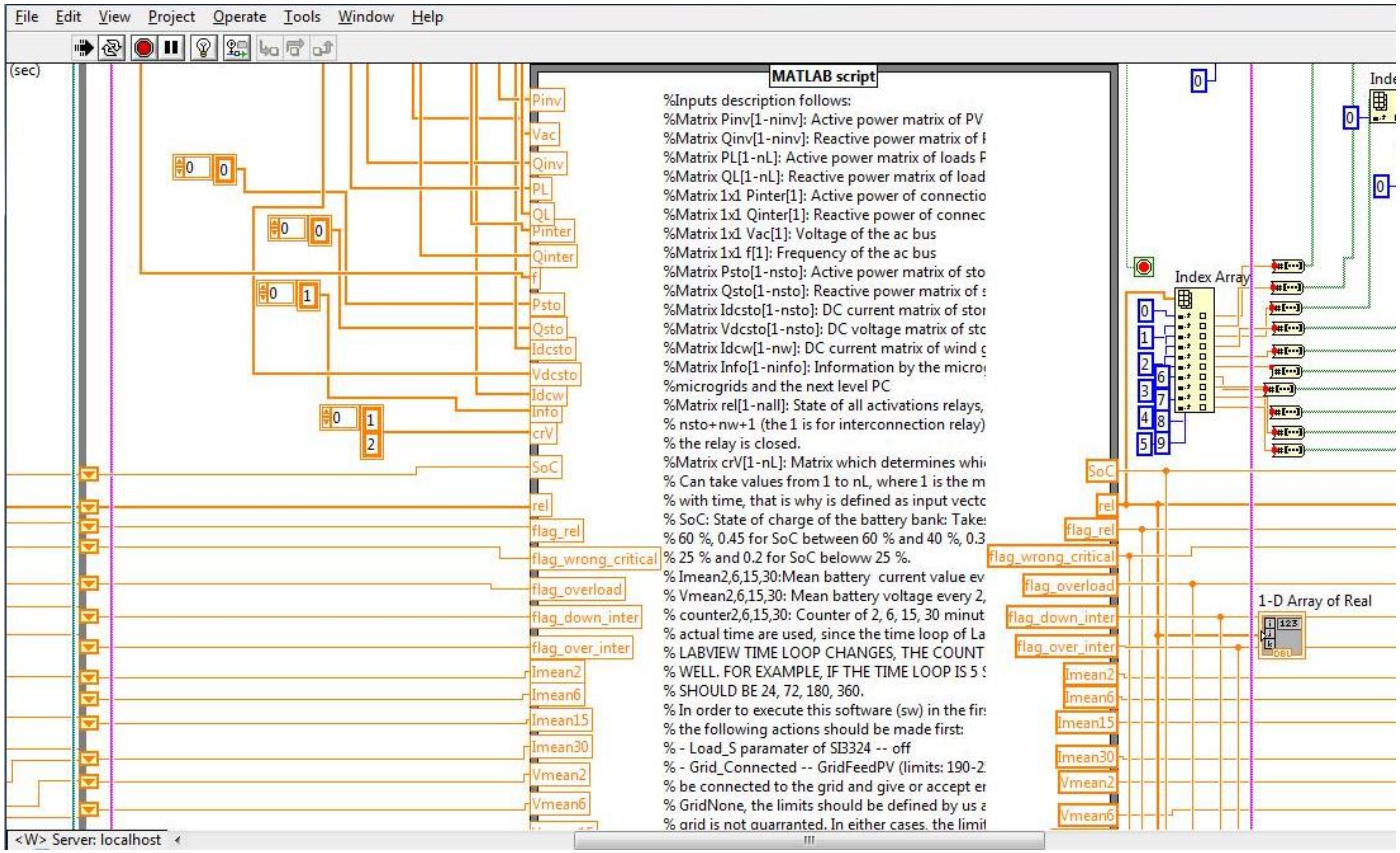


TEIWM microgrid

Special Control Units (SCUs)



Control Algorithm



Control Algorithm

➢The developed Labview application is responsible for:

✓Data sampling (12-bit resolution, 1kS/sec sampling rate) and calculation of the RMS values.
✓Calculation of other electrical parameters (active and reactive power, frequency, etc).
✓Incorporation of the control algorithm written in MatLab code.
✓Data recording.
✓Transmission of the commands derived by the control algorithm back to the digital output of the DAQ card.

Control Algorithm

- The control algorithm consists of two major steps:

✓1. The real-time voltage and frequency surveillance and correction, as well as the interoperability with the remaining grid.

✓2. The storage units' State of Charge (SoC) and the load shedding policy determination.

Control Algorithm

➢First major step:

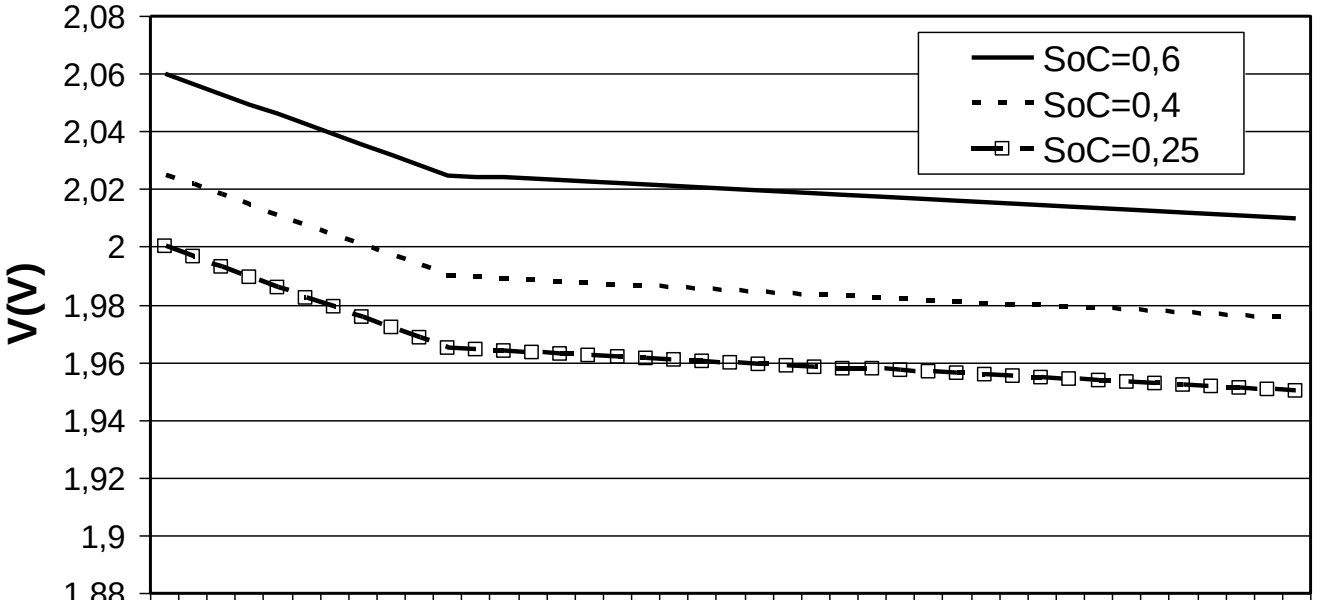
Eight routines are executed in this step and are described analytically in the full paper. Some of them are the following:

✓1) If excess active power production by the Renewable Energy Sources (RES) increases the microgrid voltage → excess power to the remaining grid. If the interconnection relay is already set to be on, the biggest RES supplier is switched off.

Control Algorithm

- Second major step:

SoC of the battery bank



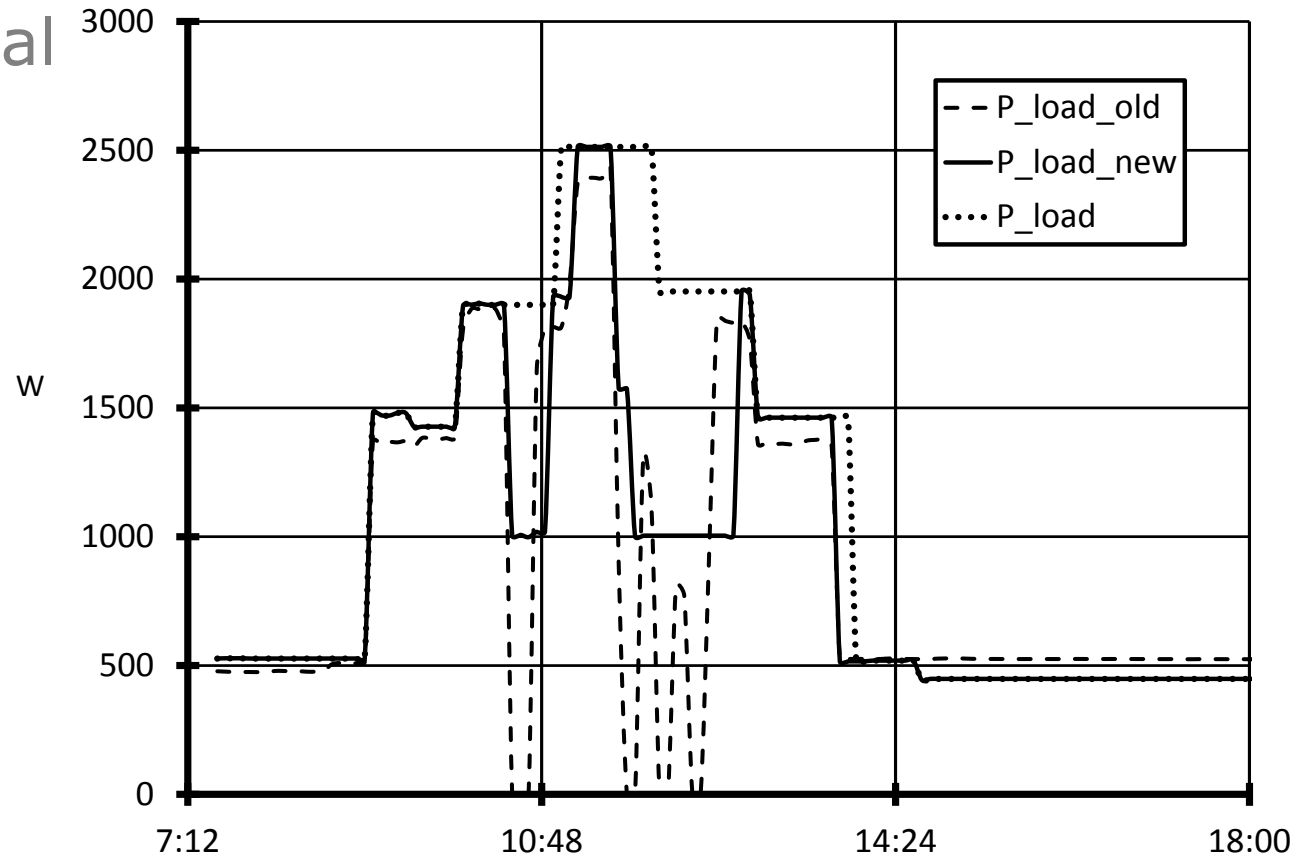
Control Algorithm

Second major step:

"Pseudo State of Charge" (pseudo-SoC) is defined as:

- The SoC that is assigned to the batteries on purpose. Great discharging currents → (Vmean-2, Imean-2) point skips one of the above SoC areas,
- I.e. The mean voltage and current over 2-minutes period appear to fall from SoC area No1 to SoC area No3 or No4.
- In this case, the batteries are assigned the pseudo-SoC, which is the missed area SoC.

Experimental Results



THANK YOU!