EEPOS - Energy management and decision support systems for energy positive neighbourhoods

SEVENTH FRAMEWORK PROGRAMME

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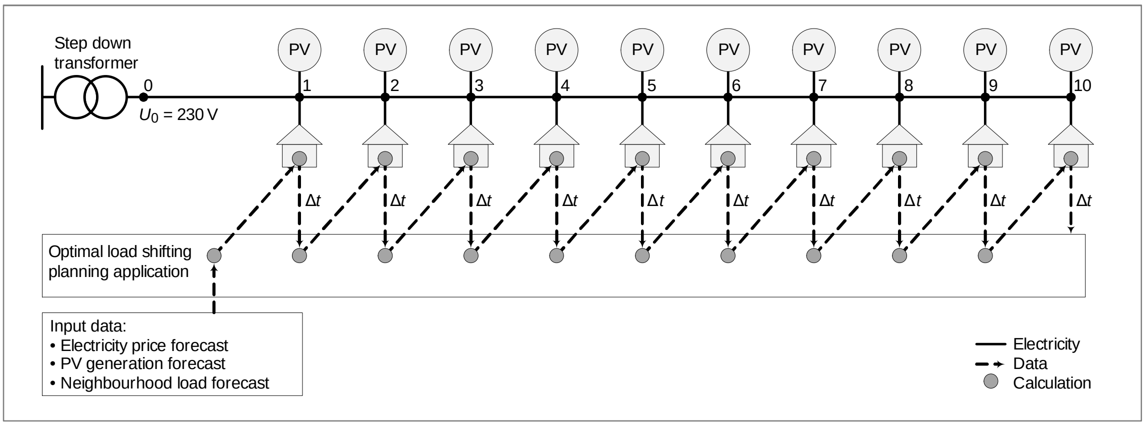
Supervisory and Predictive Control Methods and Applications: Technical documentation

Extended Summary



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1 Introduction

This summary introduces the methodology of EEPOS Neighbourhood Automation System (NAS) energy management. It describes the following OGEMA supervisory and predictive control applications:

- Photovoltaic (PV) generation forecast application
- Optimal load shifting planning application

The applications are designed to perform energy management following the technical aims of the EEPOS project:

- Maximum utilisation of local distributed energy resources (DER) in the neighbourhood
- Electricity market support (balancing market)
- Distribution grid support (congestion management, peak load shaving)
- Reduction of energy transmission and distribution losses

2 Application development

Developed applications will run on the EEPOS Automation System Platform (T2.1 “Automation platform specification and implementation”), which is based on the OGEMA framework. The core concept of OGEMA is to provide a hardware independent execution environment, where a variety of applications can run.

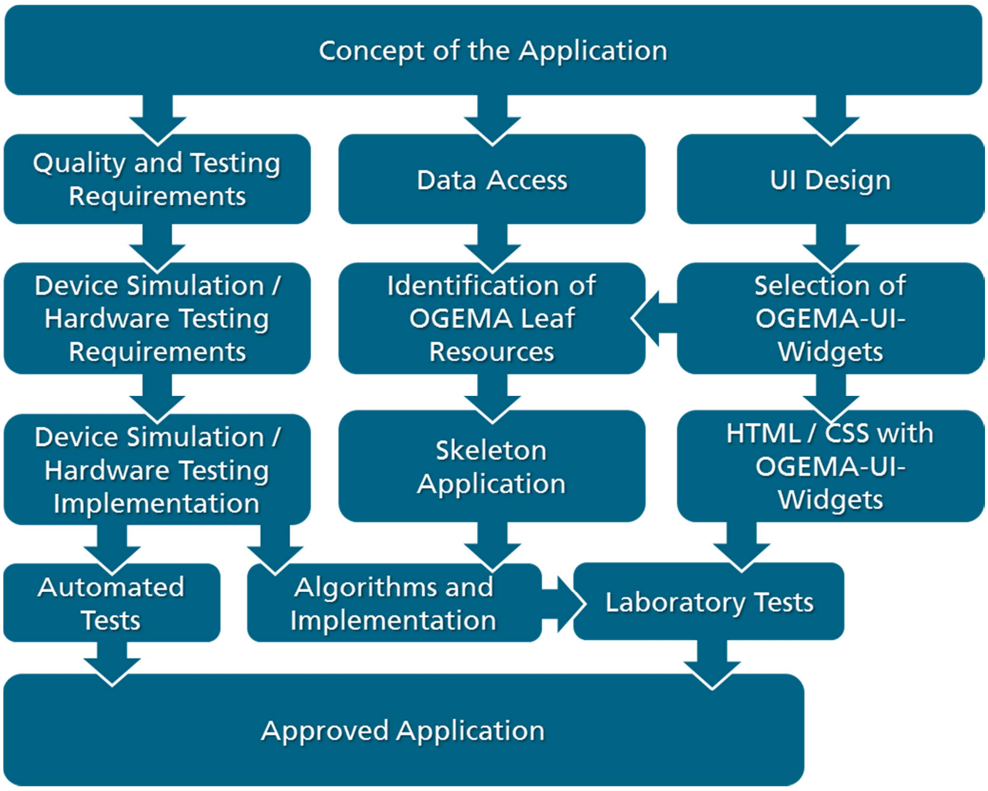

Figure 1 Schematic of the OGEMA development process

Fraunhofer offers OGEMA Development Process (ODP) to ease the development of OGEMA applications for programmers who are not familiar with the OGEMA API and data model. The ODP aims to provide a simple and standardised way to develop new OGEMA applications and drivers.

For the development of single OGEMA applications, the ODP is structured as depicted in Figure 1. For each new application, the process starts with the description of the application concept. From the following layer on, the ODP is split up into three branches starting with "quality and testing requirements", "data access" and "user interface (UI) design" (valid only if a UI is required). The steps in different branches can be carried out independently from each other.

For the first four steps, which do not require any deep knowledge of the OGEMA API and data model, Fraunhofer will provide a Word template to be filled out by the application developer.

3 Specification of the EEPOS supervisory and predictive control applications: NAS

NAS applications are designed to perform efficient management of electric load in the neighbourhood. Loads addressed by this management are all controllable electric loads and generator systems in the neighbourhood. Management is performed for loads whose operation patterns can be automated.

The PV generation forecast application calculates generation forecast profiles for those PV systems in the neighbourhood. The calculated generation forecast profiles for the PV systems serve as input data for the optimal load shifting planning application.

The optimal load shifting planning application (further in the text: load shifting application) calculates optimal load shifting profiles for the grid user's Energy Management System (EnMS) connected to the EEPOS NAS according to the following management priorities (based on the project aims):

1. Local DER surplus compensation in the neighbourhood
2. Cost effective load shifting following electricity price
3. Peak load shaving in the local electricity grid

The first and the third point will lead to a reduction of electricity transmission and distribution losses. Thus, the NAS also contributes to energy efficiency.

Optimal load shifting planning is estimated based on the data provided by (i) electricity price forecast, (ii) generation forecast of DER and (iii) predicted neighbourhood load. The latter is the neighbourhood load of the grid users which are not involved in the EEPOS EnMS. The management algorithm is presented in Figure 2.

Application execution starts when at least one of the required input data values is updated: predicted price,predicted load or DER generation forecast (Figure 2). After a time delay of 15 seconds of waiting for additional input data updates (if not already updated), the load shifting application continues with the calculation of optimal load shifting profiles, which is explained further in this section.

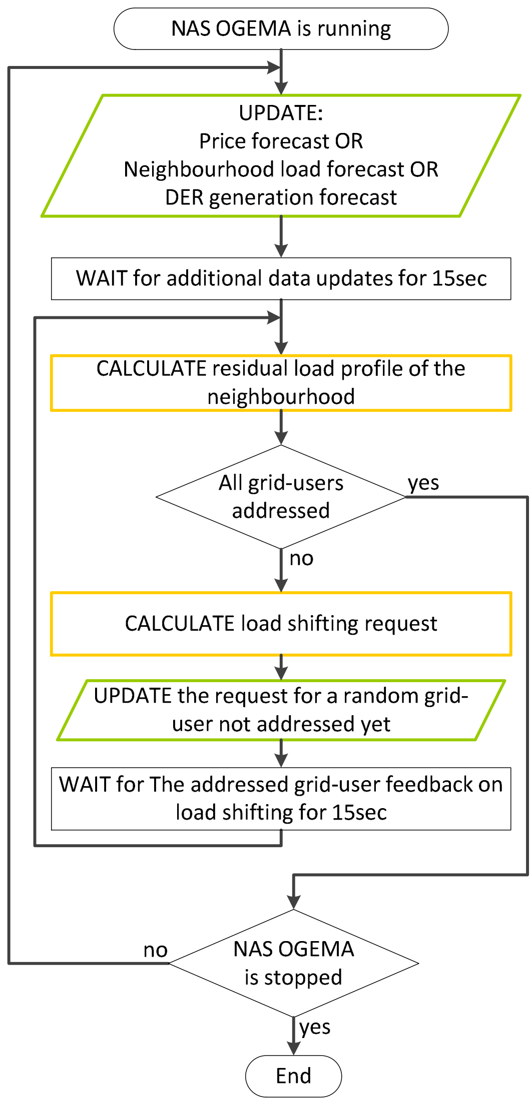

Figure 2 Flowchart of optimal load shifting planning application

It is recommended to approach individual grid-users not simultaneously but one after another with load shifting request. Approached grid users are supposed to inform the application on their load shifting plans (e.g., with the load forecast for one day ahead with average load values for every 15 minutes). This information is then taken into account for load shifting planning for the next grid user. This way, the risk of creating load peaks or off-peaks is avoided. Such management leads to the EEPOS aims without having to know precise load shifting capacity in the neighbourhood.

4 Further steps

Developed applications will be tested in the laboratory prototype (T4.2 “Laboratory prototypes”) and in the demonstration field tests in Finland and Germany (T5.1 “Demonstration in Finland” and T5.2 “Demonstration in Germany”).