Electrification Suite & Test Lab

TUMCREATE

Flexible Distribution Grid Demonstrator (FLEDGE)

Requirements and Software Architecture

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Abstract

In the distribution grid, flexible resources are becoming an important tool to address challenges from uncertain renewable generation and increasing peak loads. To this end, there exists a need for a dedicated software framework to simulate the active distribution grid operation with flexible resources. The Flexible Distribution Grid Demonstrator (FLEDGE) is presented as a simulation tool which integrates active distribution grid operation with classic power flow studies.

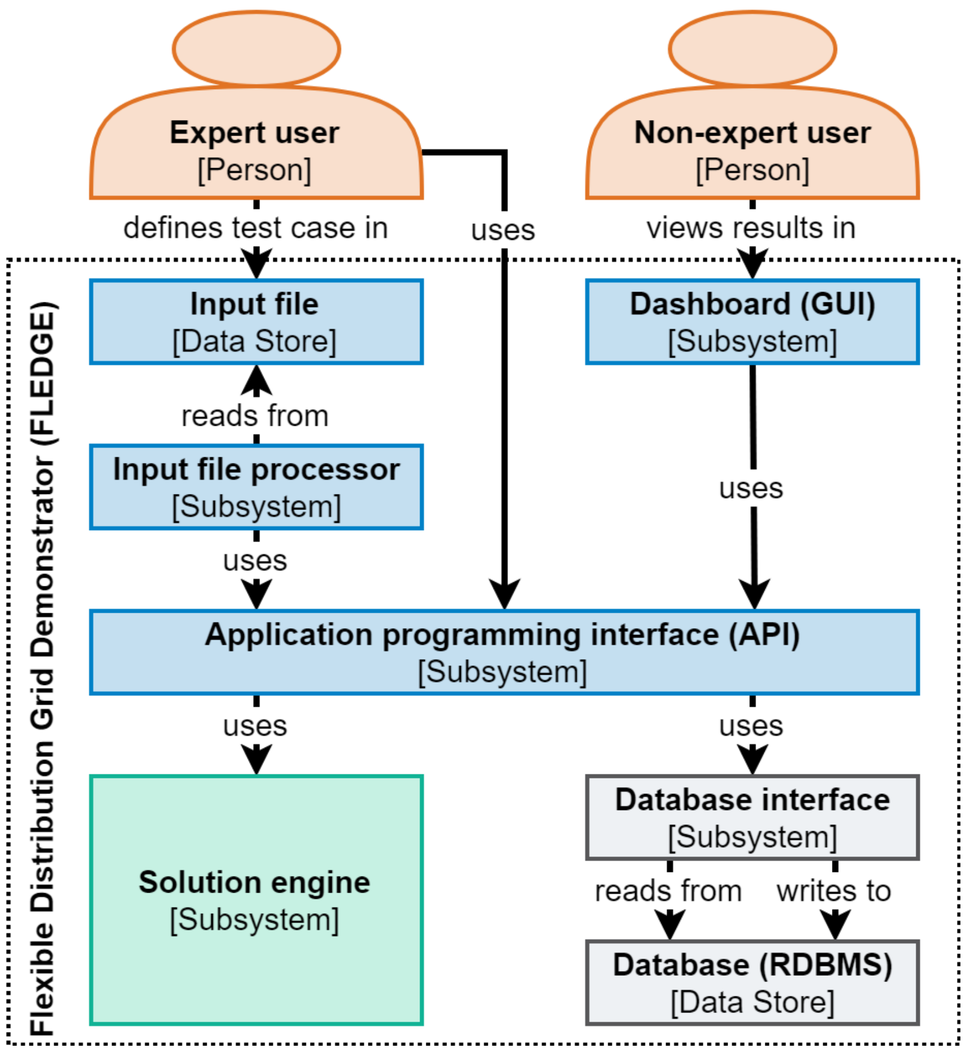
Software Requirements

The key requirements were identified through interviews with government agencies and research entities in the power system sector in Singapore:

- The software computes planning and operation problems for the distribution grid in the presence of DERs.
- The software comprises a framework to represent and compare different (numerical optimization) problem formulations for both planning an operation. This includes the ability to specify different objective functions, mathematical component models and constraints.
- The software can interface numerical optimization solvers as a tool for computing the planning and operation problems.
- The software comprises mathematical component models for the distribution grid, fixed loads, flexible loads, BESSs, EV charging and renewable generation.
- The software allows adding more mathematical component models at a later stage.
- The software allows computation of results on a scenario basis. A scenario defines the test case, problem type, problem formulation and solution parameters. The test case defines the distribution grid along with its connected DERs. The problem type is either planning or operation. The problem formulation describes which objective function, mathematical component models and constraints are being considered. Solution parameters define which solution algorithm is applied.

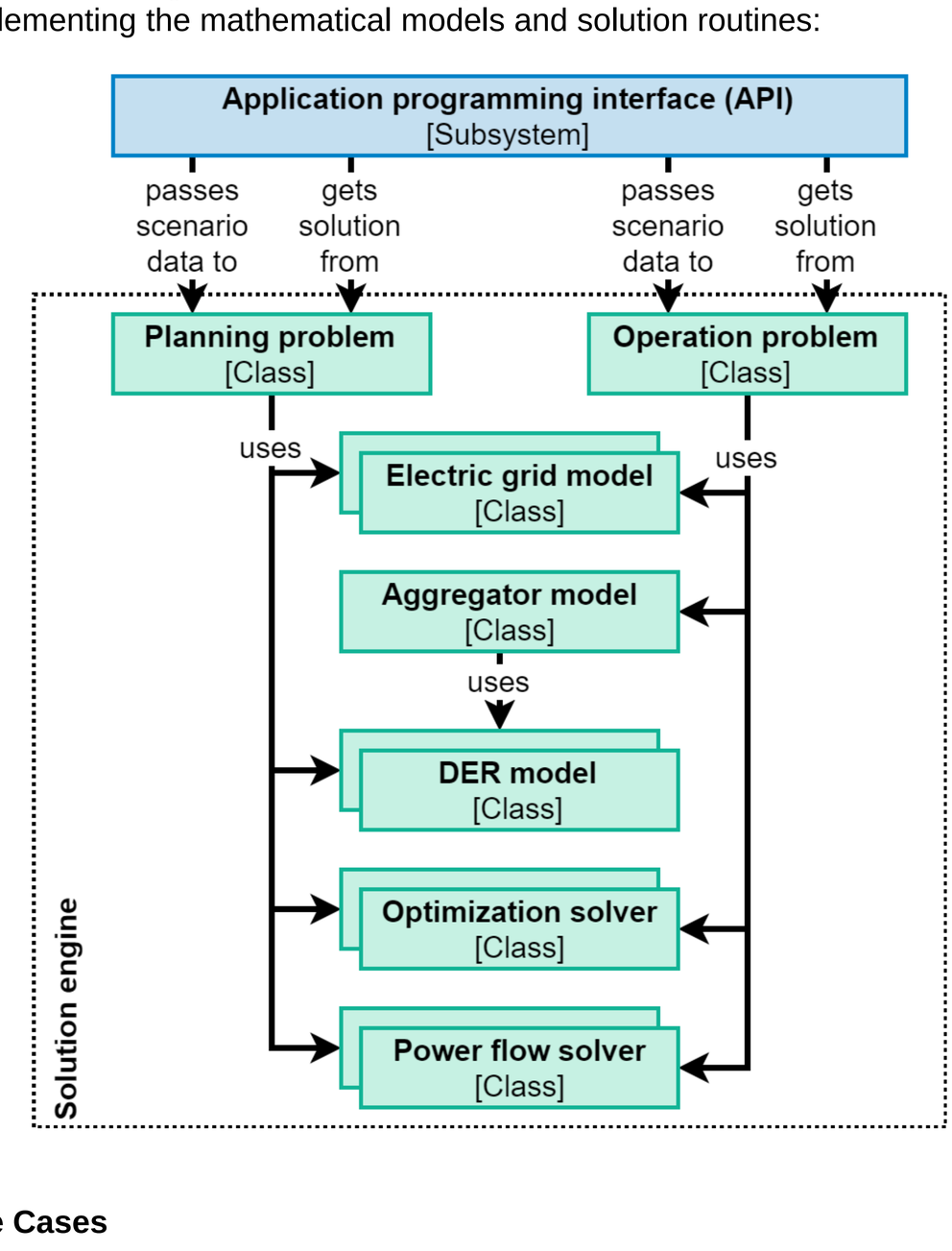
Software Architecture

Based on the requirements, the fundamental subsystems of FLEDGE are defined:



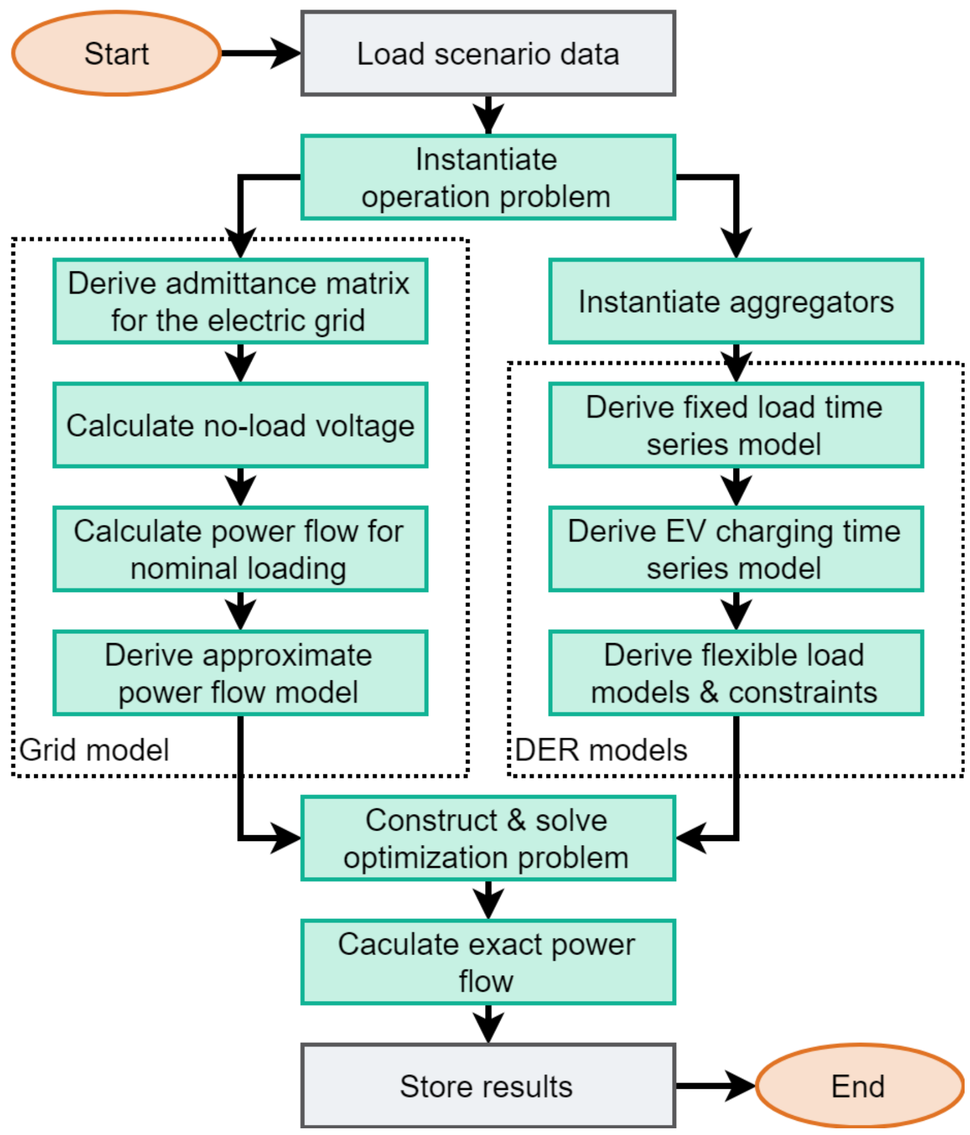
Solution Engine

The solution engine is the core subsystem which is concerned with implementing the mathematical models and solution routines:



Use Cases

Process flow for an exemplary operation problem in FLEDGE:



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