Model-Driven Engineering for Smart Grid Automation

Dissertation by

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Abstract:
The rollout of smart grid solutions has already started with new and intelligent methods being deployed to today's power systems. One of the main catalysts for this is the massive deployment of renewable energy sources in the recent years, causing new challenges for the planning and operation of the electric power system. Automation systems, using advanced information and communication technologies, are key elements to handle these new challenges. The electric energy system is moving from a single system to a system of systems. As a consequence, engineers are also faced with an increasing engineering complexity. To mitigate this complexity, proper methods and tools are needed also for the overall engineering process. Until now, such a method has been missing.

This work addresses these shortcomings with the concept for a rapid engineering methodology, covering the overall engineering process for smart grid applications—from use case design to validation and deployment. The main goal with the methodology is to improve the traditional smart grid engineering process in such a way that manual work and complexity are reduced. In order to achieve this automation, techniques from model-driven engineering is used.

The main result of the work is a formal approach for specification and design together with a concept for automatic generation and deployment of target code and configurations. The rapid engineering methodology is also compared to the performance of traditional smart grid engineering methods. It shows that the rapid engineering methodology drastically reduces the engineering and validation complexity for the engineer. At the same time, the manual effort is reduced and the rapidness of current engineering methods is significantly increased.