Project News: April 2019

The first Net2DG project newsletter provides you an overview of recently achieved project progress and interim results. Main highlights are the algorithms for grid estimation as well as the ICT gateway design. Feel free to contact us directly or post any comments at https://www.linkedin.com/groups/13592993/.

Distribution Grid Efficiency, Quality and Reliability through Digital Technologies

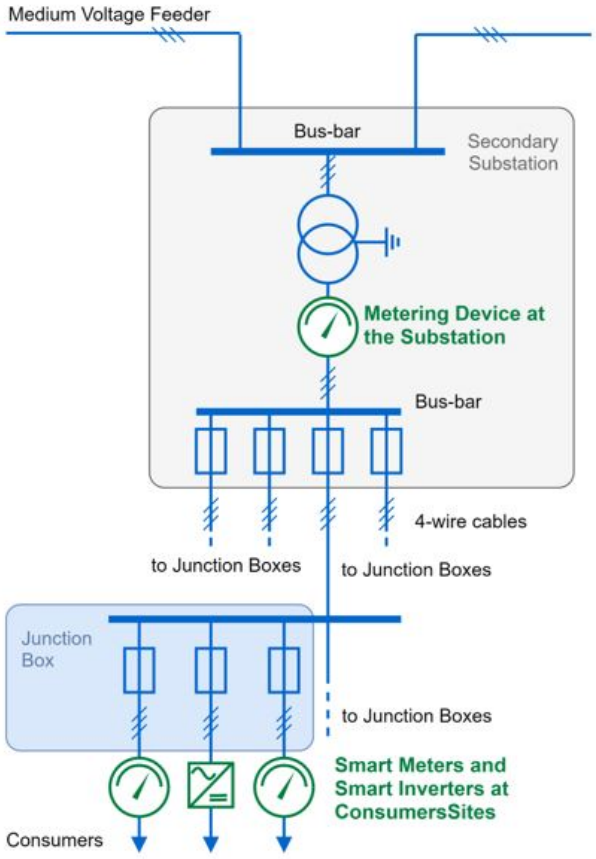
Distribution System Operators (DSOs) assure the reliable and efficient electricity supply to geographically distributed customers. There is an increasing number of digital grid-related data sources, including smart meters at customer sites or smart inverters that connect storage or distributed generation, but the information from such sources has not yet been harnessed for grid planning and operation.

The Net2DG project will develop a proof-of-concept solution based on off-the-shelf computing hardware that uses available communication technologies to leverage measurement data from smart meters and smart inverters as well as other sources in Low-Voltage grids. The Net2DG solution correlates these data with information from existing DSO subsystems, in order to enable and develop novel LV grid observability applications for **voltage quality, grid operation efficiency, and LV grid outage diagnosis**. The achieved observability is subsequently used by specifically developed novel control coordination approaches, which utilize the existing smart meter and smart inverter actuation capabilities in conjunction with selected existing DSO actuation for **voltage quality enhancement and loss minimization** in the LV grid.

Net2DG project team at the Kick-Off Event in Wels

The use of off-the-shelf components, the system level resilience and security solution, and the offered customizability of the Net2DG approach specifically address the needs of regional DSOs. Therefore, the Net2DG approach will enable regional DSOs to create value from smart meter and inverter data in a secure and privacy-protecting manner:

- Net2DG creates software solutions for DSOs, which can be installed quickly and easily and result in cost savings for DSOs.
- Net2DG solutions will reduce grid losses and outages and help with the optimization of grid operation and maintenance using available grid measurement data.



Net2DG data sources

- Net2DG will help regional DSOs become early adopters of digital technology for LV outage diagnosis, grid operation efficiency and voltage quality.
- Net2DG will enable an extended hosting capacity for the integration of renewable energy sources in the low voltage grid by the active use of remotely controllable end devices in the field.

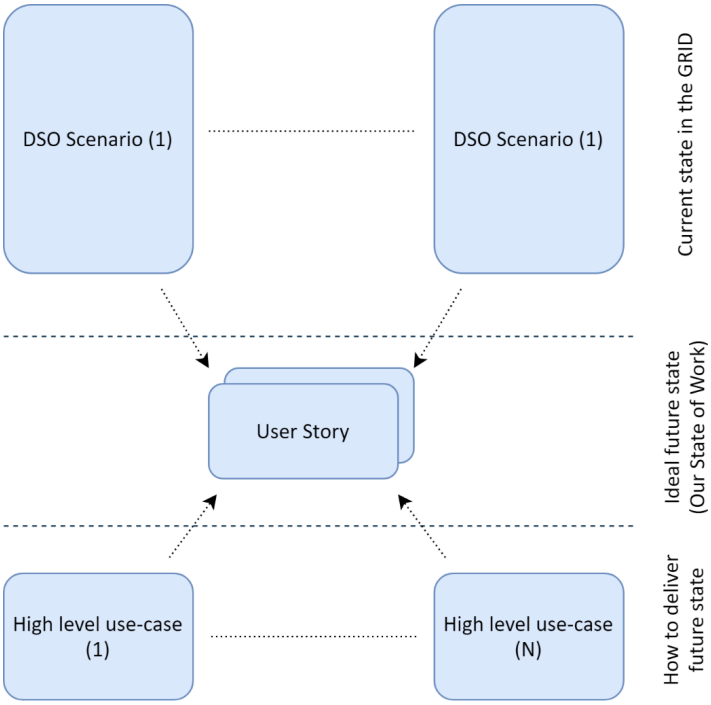
Use Cases

The Net2DG solution correlates data from smart meters and smart inverters with information from existing DSO subsystems, in order to enable and develop novel LV grid observability applications for voltage quality, grid operation efficiency, and LV grid outage diagnosis. Twelve use-cases have been defined based on specific requirements and interests from two DSOs in the consortium and from the eleven reference group members - DSOs and DSO organizations in Austria, Germany, and Denmark. A complete description of the 12 uses-cases can be found in the public deliverableD1.1 (see also www.net2dg.eu)

In Net2DG we address these use-cases by analyzing the low voltage grid operation from three different angles:

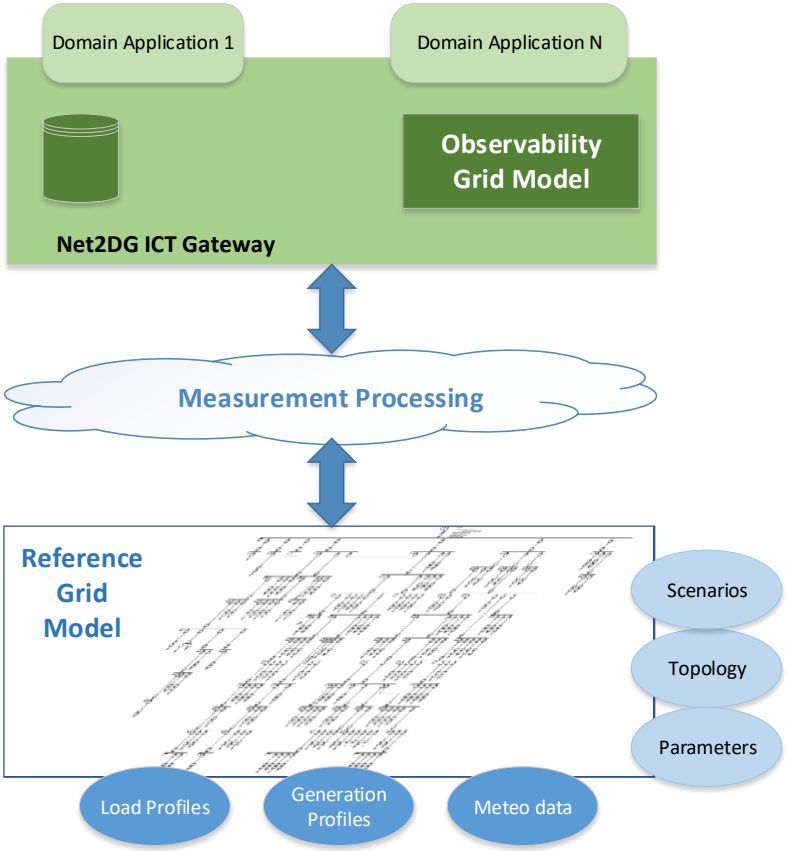
- Understanding what create outages in the low voltage grid.
- Understanding of barriers for achieving operational efficiency in the low voltage grid operation.
- Understanding what conditions hinder the delivery of optimal voltage quality to end-consumers.

The achieved knowledge has been used to identify potential improvement areas in the form of value-based user stories and corresponding high-level use cases detailing how this value can be delivered to the DSOs. The high-level use cases have formed the basis for identification of specific application requirements linked to the proposed Net2DG application architecture. This can be illustrated as follows:



Net2DG high level use cases and user stories

We present the use-cases for Net2DG and derive requirements from these use-cases. This pre-analysis also includes the inspection of first data traces in several cases. In a next step we describe the current situation with respect to energy markets and business relations of the DSOs in the consortium and build a market related future scenario.



Net2DG Reference and Observability Grid Model

Algorithms for grid estimation

Capturing properly a given distribution grid at a given moment in time is a challenging task both for DSOs but also for research purposes. Grid topologies may change during the operation. For example, cables, transformers and other power system components degrade over time. The DSO's database may not be able to capture the systems parameters. Additionally, smart meters and other measurement devices have an inaccuracy of measurement. All these issues have a large impact on the Net2DG's observability applications. Therefore, the actual operating conditions need to be captured properly by using appropriate models.

- The Reference Grid Model (RGM) is a representation of the real world used to reproduce events and operational challenges similar to daily operation of a distribution grid. All parameters are known with a minimum uncertainty and all variables are ideally available without accounting for measurement errors. This model is implemented in a selected simulation tool that supports the research activities in Net2DG.
- The Observability Grid Model is maintained within the Net2DG ICT Gateway, which is built based on various information sources available at DSO level. Typically, the information to characterize a given distribution grid is available in various formats and data bases. This model is the basis for supporting the observability applications taking into account not only the information but also considering feasible technical assumptions when information is missing. All observability applications can be compared with the RGM that will provide all the information assuming perfect knowledge and availability of data, measurements, etc.

ICT Gateway Design

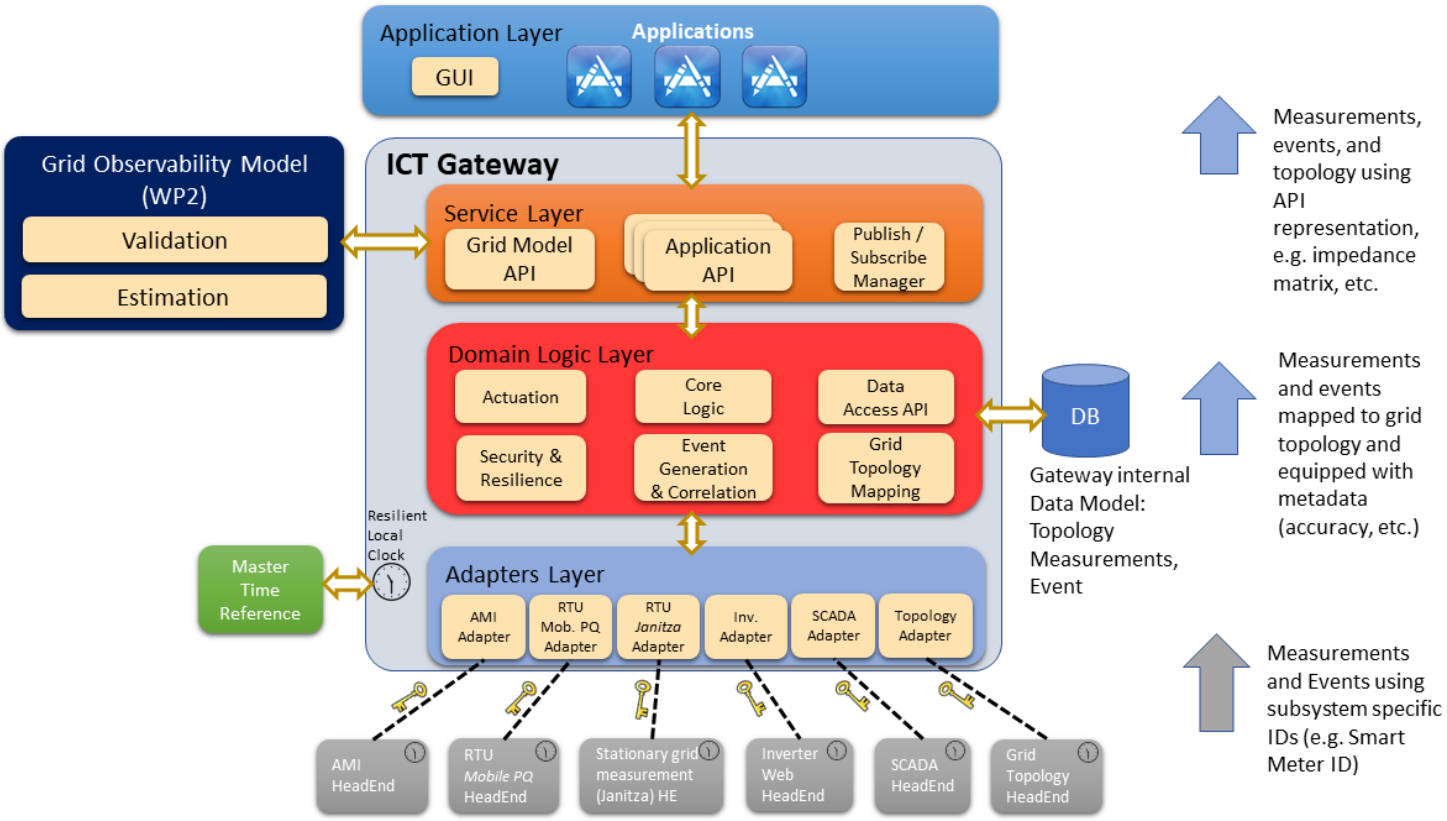
The ICT Gateway represents the central entity within the overall Net2DG solution. It connects to the smart meter data management system, to the smart inverter portals as well as to the relevant DSO internal subsystems (including in particular the grid topology subsystem).

The complexity of the overall communication architecture in Net2DG requires that the ICT Gateway is able to use a variety of interfaces, protocols and data models for interfacing with various heterogeneous subsystems. Therefore, the ICT GW contains for each connected subsystem a *subsystem adapter*, which ensures that the ICT Gateway is able to communicate via the appropriate protocols for the specific subsystem. The point of contact on the subsystem is the so-called Head-End.

All the collected data coming from the subsystems are then organized and properly stored in order to generate events correlating multiple measurements and make them available to the application layer. Furthermore, the ICT Gateway handles interactions with actuation subsystems to send setpoint modifications or resets. It also interacts with the Grid Observability Model in order to get an estimation and validation of electric variables at any grid point, even when these are not available from the field.

Finally, the ICT Gateway includes advanced functionalities contributing to resilience and security through the implementation of specific fault and attack detection mechanisms.

The following figure shows the main building blocks of the high level ICT Gateway architecture divided into different layers: *Service Layer, Domain Logic Layer* and *Adapters Layer*.



Net2DG ICT Gateway

Reference Group

Net2DG is successfully working with DSOs in the context of the Reference Group, with 11 DSO participants from Austria, Denmark, and Germany.

The Net2DG Reference Group was installed early in the project to widen the feedback by the project's core audience (in addition to the two DSOs actively participating). In the first series of discussions, the focus was on use-cases, their prioritization, and the project goals. The feedback of the reference group members is reflected in the 2018 deliverables

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