Innovating Electricity Distribution in Europe

Frame Programme 7 - Cooperation Project

DREAM - Distributed Renewable resources Exploitation in electric grids through Advanced heterarchical Management

Project website address: http://www.dream-smartgrid.eu/

This is the second issue of the newsletter published by the DREAM Project, launched in 2013 and funded by the European Commission within the 7th Frame Programme of Research and technological Development.

This release offers to the readers information on recent and ongoing publication activities. The newsletter is transmitted by e-mail to the subscribers, and is also made available through the project web site at the document download page.

SUMMARY DESCRIPTION OF PROJECT CONTEXT AND OBJECTIVES

The DREAM project (September 2013 – August 2016) is building the foundations for a novel heterarchical management approach of complex electrical power grids, providing new mechanisms for consumer involvement in economic and ecological electricity use as well as stable and cost effective integration of distributed renewable resources.

Applying the principles of autonomous agent-based systems to the control and management of the electricity distribution grid will allow the system to constantly adjust to current operational conditions and make it robust to exogenous disturbances. In turn, this allows for greater penetration of intermittent resources and will make the distribution grid more resilient to failures.

DREAM is including several layers of controls for normal, congested and post-contingency situations that uses different coordination strategies ranging from market-based transactions to emergency demand response and create ad-hoc federations of agents that flexibly adjust their hierarchy to grid needs.

The objectives of the project is thus to create advanced tools and methodologies, for the Distribution System Operator (DSO), with a bottom-up approach spreading the necessary algorithms to take the local decisions. This intelligence, delegation from the operator, is spread inside local advanced Remote Terminal Units. These units, under the responsibility of DSOs are enabling local market operation and validating flexibility offers. Contingency analyses are as well embedded in day ahead, intraday and near real time markets. Distributed Energy Resources (DER) flexibility can be used to increase the best use of existing assets, combined with intrinsic grid flexibility (voltage management, optimal power flow, reconfiguration, among others).

The system will then transit smoothly between control layers depending on local operational conditions, so that responses to disturbances are sized precisely, margins are used parsimoniously and full network flexibility is tapped. With a bottom-up approach, the system should involve only

limited data transfers and fewer centralized control, promoting extensibility, heterogeneity and easy deployment across countries with different network architectures and hardware manufacturers.

WINTER SCHOOL IN GRENOBLE

On December 14th to 17th, 2015 Grenoble INP – ENSE3 hosted the DREAM Winter School, a four day meeting with the participation of 120 experts and students focused on distributed intelligence for Smart Grids, with special interest on agent based coordination, rural areas or congestion management.

Coordinated by Prof. Raphael Caire, Scientific Coordinator of the DREAM project, the event invited outstanding speakers from the DREAM, INCREASE and IDE4L consortia and contributed to fostering exchanges and expertise between the twin projects.

Approximately 80 Master Students – in link with KIC Innoenergy – and 10 PhD students from different European universities benefited from the experience!

Several presentations (movies and slides) are publicly available and can be viewed or downloaded from the dedicated page in the DREAM web site.

NEW PLANNED PUBLICATIONS

Leveraging its research results, DREAM is now fully focusing on experiments and demonstrations in real energy distribution environments and in advanced simulation facilities.

At this stage of the project, dissemination of scientific results is of utmost importance. To that end, several research topics will be published and possibly presented in Conferences.

Under the coordination of Rieke Baerenfaenger from the University of ST Gallen, a team is preparing a publication to report the project findings related to the ***Classification of Flexibility Types in Smart Electric Distribution Grids***.

“Flexibility” is often an ambiguous concept in the context of smart distribution grids. New technical smart grid solutions are usually designed for one particular use case, for example a use case targeted to a specific actor in a specific grid level at a specific time horizon. These solutions therefore have their very own understanding of flexibility.

DREAM will propose own flexibility description methodology (a “taxonomy”), which allows to unambiguously define the type of flexibility used by a specific smart grid use case depending on the purpose and context of the flexibility. This will include the capability to list and define the main flexibility types that are required for advanced heterarchical management in the distribution grid and explain how they relate to each other over time.
The main benefit of this taxonomy is that it may remove communication barriers in large smart grid research and practical implementation projects, which are caused by implicit assumptions of a use case developer about the use case context. It may thereby speed up implementation of new mechanisms in the field and improve the transferability of results from one project to another. Modeling different flexibility types should also help identify possible conflicts from using the same flexibility in real-world applications.

Under the leadership of René Kamphuis from TNO, a project team is in charge of the publication on the theme of multi-objective **heterarchic hybrid coordination strategy**.

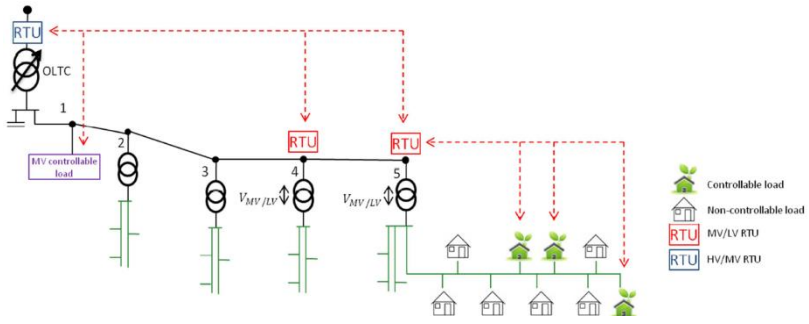
This would be focused on the case of a hybrid coordination strategy for congestion management and market optimization using the DREAM framework.

A heterarchic, hybrid software agent based market approach is applied in a simulated grid segment the size of a residential neighbourhood with heat pumps and electricity storage systems.

The agents express their flexibility into bid-curves using the PowerMatcher platform. Additionally, in contingency situations, flexibility offers from device agents are available.

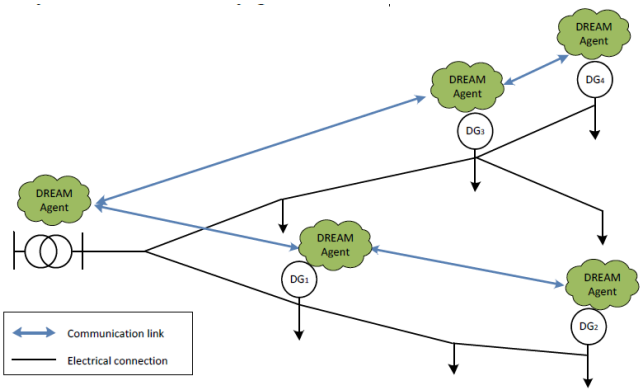
Using arbitrage with bid ladders, these offers are combined to allocate the most suited devices to deliver demand response in the affected area. Results are analyzed in terms of realized comfort and amount of stored electricity.

Emmanuelle Vanet from the University of Grenoble is addressing an additional publication subject, related to the **optimised activation of flexibility for the management of distribution constraints**, where the LV4MV concept is exploited.



The objective of this method is to prepare flexibility provision and to plan the best economic activation of MV and LV flexibility offers to solve the cases of MV constraints deviations caused by the increased penetration of Distributed Energy Resources (DER), while ensuring that LV network constraints are satisfied.In the presented context, end user’s flexibility is the modification of generation and/or consumption patterns (both demand and supply side). Instead of using LV flexibilities locally, the provision of them for MV level would enable a better repartition of the flexibility offers and would ensure fairer and lower prices in the MV local market.

Last but not least, a team coordinated by Iasonas Kouveliotis-Lysikatos from the University of Athens is addressing the overview of the decentralized techniques for the operation of the distribution grid that were developed within the FP7 project DREAM.
The solution addressed is threefold and copes with the energy imbalances at the distribution level in an intra-day market based procedure, voltage deviation mitigation and congestion management.



The decentralized control scheme derives from the necessity to disperse the intelligence of the various controllable entities of the power grid in order to reduce the complexity of the optimization of the operation of the distribution system. Thus, a central data fusion center is no longer required and the robustness of the grid is increased since the control decisions are calculated using local interactions (peer-to-peer only communication) following strategies that lead to globally optimal solutions.

Three developed techniques will be addressed, formulated as distributed resource allocation problems incorporating all the grid and end user constraints and at the same time minimizing the total cost of the operation.

The publications will be made available on the web site, either in full text for free whenever allowed by the publisher, or in abstract with the reference to the location of the full official version.

DREAM PROJECT PRESENTING PROGRESS & RESULTS AT INNOGRID2020+

The DREAM Project has been invited to the next InnoGrid2020+ Conference in Brussels on Digital Energy. Three people will attend and will be at the exhibition stand for a poster based presentation.

The 5th edition of InnoGrid2020+ is scheduled to take place over 22nd and 23rd March at the Center for Fine Arts in Brussels.

This year's conference will focus on "Digital Energy". It will address the innovation paradigm behind the distribution and transmission interface and will also take stock of on-going R&D projects. Finally, it will address the question of how regulation could facilitate innovation in the new power system. Beyond engaging presentations, panel sessions and debates, InnoGrid2020+ will run a poster and exhibition session, enabling participants to interact and share knowledge and best practices.

DREAM PARTICIPATION TO THE FOURTH WORKSHOP OF THE DISCERN PROJECT

The fourth workshop of the DISCERN project was held in Brussels on 28th January 2016.

The event was dedicated to Key Performance Indicators, aiming at discussing the findings and experiences (positive and negative) of using a KPI based approach for project evaluation with several Smart Grids initiatives.

The Dream project had the participation of Mr Juan Luis Garrote from TELVENT / Schneider Electric, and Ms Rieke Baerenfaenger from the University of St. Gallen.

The presentation given by Juan Luis Garrote can be downloaded in pdf format from the download page in the DREAM web site.