fenix
Flexible Electricity Networks to Integrate the eXpected 'energy evolution'
... a step towards the future of electricity network

Bulletin 5
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Towards Virtual Power Plant integration into the Transmission and Distribution grid tools...

Editorial

by M. Sebastian, EDF France
FENIX Work Package 2 leader

Welcome to the 5th edition of the FENIX project bulletin. FENIX is an European co-funded integrated project. In this issue, we present the main results obtained so far by the WP2 "Electrical and information system architecture adapted to the presence of LSVPP".

The key aspect of the FENIX approach is to fully integrate DER and demand side participation using the Large-Scale Virtual Power Plant (LSVPP) concept. This concept can be described as an aggregation of a large number of DERs including different DER technologies, responsive loads and storage devices which, once integrated, should be flexible and controllable in a process similar to large conventional power plants. To achieve this, distributed control system architectures need to be designed as appropriate communication and information infrastructure to implement distributed control. Further, an appropriate market and commercial structure must be designed to support exchange of services among all players including TSOs, DSOs and LSVPPs.

Consequently, DG's participation & contribution to electricity markets must be taken into account by control engineers when monitoring and controlling the grid. Transmission and distribution operators will have to apply new functions such as real time voltage control using aggregated DG. To face the diversity and the complexity of new critical situations, the tools developed will help control engineers by having access to this aggregated means to anticipate or to face more efficiently constraining situations the day ahead or a few minutes before.

Functional Requirements

The first part of the WP2 consists in specifying system operator's tools that are required to operate power systems including a large penetration of DER through Virtual Power Plants. Four "use-cases", describing the usage of VPP in Northern and Southern scenarios, have been built, as follows:

- Use Case 1: FENIX Southern Scenario - CVPP Participate to Day Ahead Market.
- Use Case 2: FENIX Northern Scenario – Day ahead and Balancing Market Participation.
- Use Case 3: FENIX Northern Scenario – Post Gate Closure Portfolio Balancing.
- Use Case 4: FENIX Southern Scenario - Voltage VAr Control.

These functional requirements have helped us to determine the system architecture as well as CVPP and TVPP functionalities.

Technical Specifications

For each of these uses-cases, a mock up (Figure1) has been created as a *story board description* of the different process and relationship between all players. It also illustrates the control engineer HMI.

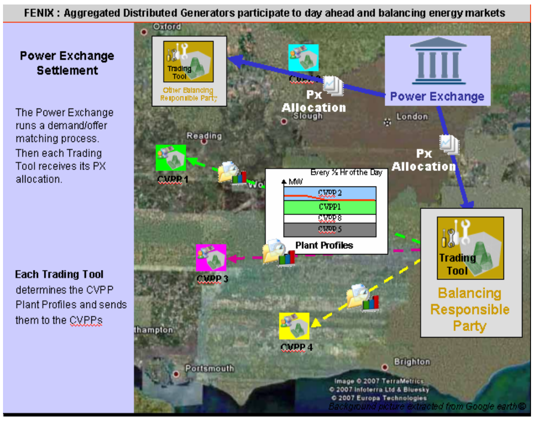

Figure 1 : Mockup example

The core aspects of FENIX include the three interdependent subjects of research whose outcome will form the basis for the operation of future highly decentralised electricity supply systems :

- Distributed system control architecture;
- Information and communication architecture;
- Supporting market and commercial structure.

General Fenix Architecture Diagram (Figure 2) can be applied anywhere in Europe and host three new pieces of equipment with their own applications:

1. Fenix Box server: applications to aggregate loads and generation and ensures their optimal use.

2. Commercial VPP * server: schedule and energy optimisation functions for DER units.

3. Technical VPP * in the DMS server: applications for the validation of the generation schedules taking into account voltage and current violations.

UML language has been applied in order to create the technical specs of the FENIX demonstrating tools, to describe the "use-cases" and to improve the understanding, in the manufactures, of the specification. The main outcome of FENIX is to have various contributors interacting with each other. In order for this to work, interoperability between players must be assured. Using approved recognized standards is an good route to follow.

UML actors diagram (Figure 3) describes the links between FENIX players.

* *See former bulletin for precise description*

Co-ordination:
Iberdrola Distribución
José Manuel Corera
Avda San Adrián, 45
Bilbao 48003
SPAIN
phone: +34 94 466 32 62
fax: +34 94 466 31 94
j.corera@iberdrola.es

The Co-ordination action is supported by the EC under the 6th framework programme
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www.fenix-project.org

Bulletin Editor:
Michael Durstewitz
ISET
mdurstewitz@iset.uni-kassel.de

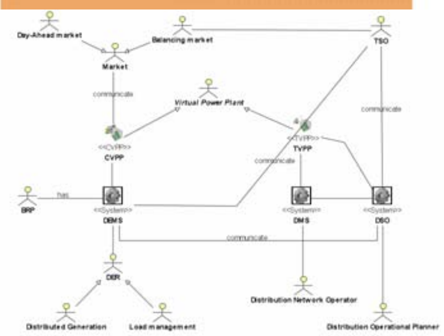

Figure 3: UML Actors Diagram

Authors:

Maria SEBASTIAN (FR)

Joseph MAIRE (FR)

CVPP Functions

The DER units are grouped for commercial reasons in CVPPs. Not all CVPP functions will be tested in the experimental phase.

The CVPP must allow the DER owner to determine his own technical parameters and to manifest his planned equipment's outages. In order to run the Fenix demonstration, the following CVPP functions must be in place:

• Maintenance and submission of static physical characteristics of DERs.

• Administration of planned and non-planned outages on a long, medium and a short-term basis.

• Forecasting of generation based on weather data.

• Forecasting of demand based on demand profiles.

• Outages Demand Management.

• Building DER bids.

• Submission of bids to the market and balancing offers to the TSO.

• Day-to-day optimisation and re-balancing of real-time generation.

The CVPP will sell energy provided by the DERs to the wholesale market. It can sign bi-lateral trades with other market players or place the energy blocks on the market.

On the other hand, Traders need to have the following functions in place in order to communicate with the day-ahead market as well as the balancing mechanism/market:

• Flexible management of physical trades.

• Calculation of risk of a trade portfolio against price forward curve.

• Possibilities of bi-lateral communication between the CVPP/Trader, the day-ahead market and the balancing mechanism.

• Meter reading.

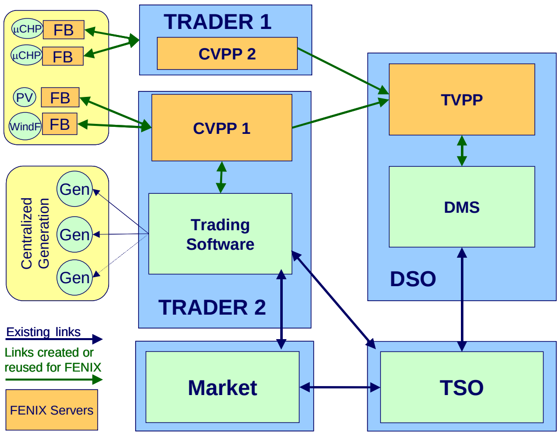

Figure 2: Fenix General Architecture

TVPP Functions

The TVPP is a part of the SCADA / DMS (Distribution Management System) of the network control system. The TVPP has two main functions:

• Feasibility check of the base schedules within the distribution network.

• In the event of problem detection, recommend remedial actions to provide a feasible combination of schedules and network configuration.

The TVPP requires these functions to be in place:

• Feasibility, calculation & evaluation of scheduled generation values of the DER units.

• In the event of problems detected in the distribution network caused due to basic schedules, planning of corrective measures such as: topological changes or changes of the setting of voltage controllers in the network, changes of scheduled generation values of DER units, load shedding.

• Validation of day-ahead schedules.

• Same day verification of the DSO schedule.

• Switching procedures for safe re-configuration of the network management.

•Volt VAr Control (VVC).

Real-Time Volt VAr Control

DSO needs a VVC to optimise the voltage in the network. The VVC application is a part of the TVPP. It helps the operator to manage and optimise constraints. VVC a numerical optimisation algorithm that takes into account objectives and constraints. Within the numerical optimisation language, the word "constraint" means that the optimisation process can not compute a solution that exceeds limits defined with this constraint. This new VVC system is made of a coordination of local self-adjustable voltage control. Using the measurement of Voltage and Currents, VVC determines the optimal set point for each component (DER, capacitor banks and Transformer Tape Changer).

Industrial Design and Development

CVPP and TVVP functions has been developed and implemented, in 2008, by AREVA and Siemens in their respective tools e-terra and Spectrum. These will be tested during the last year of the project in UK and in Spain.

Next FENIX bulletin

The next FENIX bulletin will be published in February 2009.

Subject: The Southern Scenario – A presen-tation of the demonstration task in a 33 kV network in Spain with many DER on-line.

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