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Scalable and Usable Web Based Supervisory and Control System for Microgrid Management

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Abstract. The aim of this work is the development of a standars-based Web SCADA that allows the control and supervision of a microgrid. It was designed for usability, incorporating an user-friendly human machine interface (HMI) based on mash-up philosophy.

One of the principal advantages of microgrids is the reduction of production cost and of energy consumption. A SCADA offers the possibility of monitoring and controlling the functioning of the system and therefore to visualize any variable; as well as any abnormal state of the system, easing the management of any process. Through the use of a SCADA, the user has total knowledge of the functioning of every element, and can interact with the microgrid by means of intuitive interfaces and simple screens which can be personalized.

There are several types of microgrids according to criteria of physical structure or performance objectives. In this case The SCADA is focused on a microgrid with the following characteristics:

- Connected Mode: The microgrid is connected to the main network.
- Hierarquical based control system: There is a Central Controller that heads the control system. At the second level, there are controllers located at microsources which exchange information with the Central Controller and are in charge of the operation at each microgrid's point.
- Minimal energy exchange: Minimize fuel consumption and control cost and emissions while satisfying power demand with a minimal energy exchange with the main network.
- The control algorithm to govern the microgrid will decide, according to the criteria of minimum cost, what is the optimal production allocation. Using this algorithm, microgrids can be power controlled on-line, minimizing running cost and greenhouse. This algorithm uses external data such as the number of microsources of the microgrid, fuel cost used by each energy source and their efficiency functions which must be inserted in the system. A SCADA facilitates the job allowing easy introduction of configuration variables at any time.

The overall architecture comprises the following components or software layers:

- An OPC-DA Client that is responsible for the interaction with the OPC-DA servers, wich are usually provided by the equipment manufacturer. OPC client are usually used for transferring real time data from PLC's and other control devices to HMIs and other clients. In this case, the OPC-DA client is used for transferring real time data from the Central Controller to the XML-DA Server and from XML-DA Server to the Central Controller. The OPC-DA client is built according to the OPC Specification.

- A XML-DA Server that communicates with the OPD-DA Client and allows sharing and interchange of real time data from field devices of a wide range of platforms. The XML-DA Server is based on the OPC XML-DA specification. OPC XML data access is the adoption of XML technology by the OPC Foundation to facilitate data interchange from the plant to Internet and to the business domain.

- A Rest Gateway that is a REST component which allows access to the XML-DA Server data from the web in a RESTful way. The Rest Gateway acts as a translator between the whole system and the web architecture; it is the module that allows data request from any system connected to the Internet giving the system modularity and scalability.

- A Web interface that is developed using the Web mash-up philosophy. These applications are web sites or web applications. The free-software EzWeb platform is used as a mash-up Web Interface. Using EzWeb, the user can create an advance operational environment from simple elements and the user can adapt the system by simply introducing information by means of intuitive screens.

The proposed SCADA is a simple architecture based on the OPC standard for communication with processes. This is what makes the SCADA hardware-independent. It is a control and supervision system that uses a mash-up web interface which facilitates customization. Because it has a web architecture, it also facilitates access to the system with a simple web browser. It is also possible to use the system from various platforms or devices. The screens have been designed so that any user can supervise the system without extensive knowledge of the SCADA.
The proposed SCADA is a simple, usable alternative which solves the supervision and control needs of a microgrid.