Pacific Northwest NATIONAL LABORATORY

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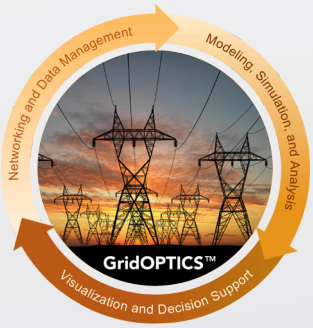


FUTURE POWER GRID INITIATIVE

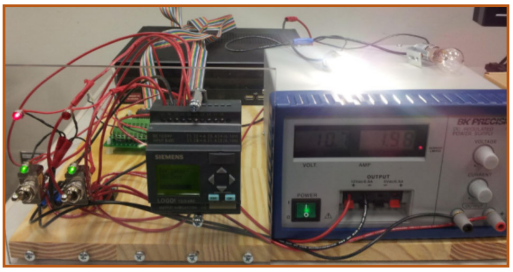
Intelligent Networked Sensors Capable of Autonomous, Adaptive Operations in the Electric Power System

OBJECTIVE

- Create an intelligent software framework for electric power system sensors and controllers, capable of executing on devices with low computational capabilities
- Enable increased information network scalability and support distributed control applications such as transactive control

APPROACH

Create a framework (called VOLTTRON within this project) that allows development of intelligent power system devices. The features of the framework are:



Hardware demo setup and Conceptual Design of Water Heater Load Scheduling

- Low computational overhead to be able to run on low-power embedded sensors
- Context-aware sensors that distinguish between normal and abnormal conditions
- Hardware and software for intelligent sensors that collect multiple types of information such as power metering and information network status
- Sensor communication protocols that support multiplexing several types of data into a single communications channel
- Protocols to share information between sensors across a wide area in order to improve situational awareness and enable event correlation
- Policy-based, context-aware management systems to configure and operate large numbers of intelligent sensors in a scalable manner
- Autonomously operating sensors based on sensed or prescribed conditions when disconnected from the rest of the power grid and reconnect and synchronize without loss of functionality

U.S. DEPARTMENT OF ENERGY

FOCUS AREA 1 - NETWORK AND DATA MANAGEMENT

IMPACT

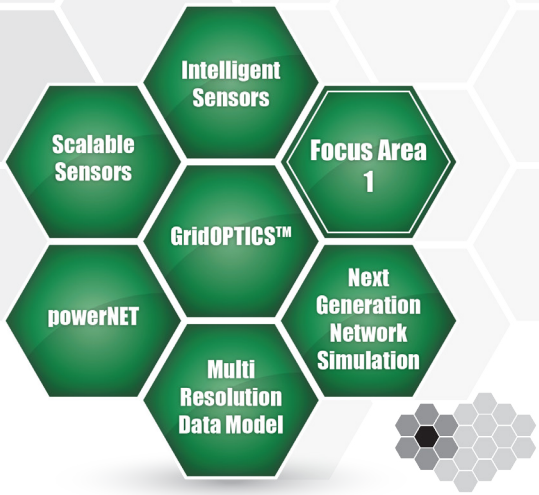
VOLTTRON will support the distribution system for managing distributed generation, demand-response, and plug-in electric vehicles. It:

- Lays the software platform groundwork for distributed operation and control of the electric power system
- Supports the distribution layer where end customers are being served
- Is designed and implemented as a platform service and framework that is decoupled from the agent execution environments

A prototype implementation of VOLTTRON has been written in Python (v2.7.2), and we have executed agents written in Python and Java and as shell scripts.

FOCUS AREA

Focus Area One addresses data networking and management issues, and enables the digital infrastructure for the future grid. This focus area will address the gaps in networking and real-time data management by developing advanced algorithms and software tools and techniques. **Focus Area Leads:** Bora Akyol (bora@pnnl.gov) and Harold Kirkham (harold.kirkham@pnnl.gov)



ABOUT FPGI

The Future Power Grid Initiative (FPGI) will deliver next-generation concepts and tools for grid operation and planning and ensure a more secure, efficient and reliable future grid. Building on the Electricity Infrastructure Operations Center (EIOC), the Pacific Northwest National Laboratory's (PNNL) national electric grid research facility, the FPGI will advance the science and develop the technologies necessary for meeting the nation's expectations for a highly reliable and efficient electric grid, reducing carbon emissions and our dependence on foreign oil.

ABOUT PNNL

Pacific Northwest National Laboratory is a Department of Energy Office of Science national laboratory where interdisciplinary teams advance science and technology and deliver solutions to America's most intractable problems in energy, the environment and national security. PNNL employs 4,900 staff, has an annual budget of nearly $1.1 billion, and has been managed by Ohio-based Battelle since the lab's inception in 1965.

For more information, please visit the FPGI website or contact:

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