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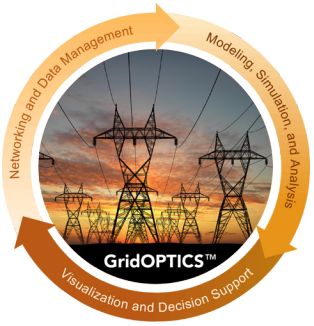

FUTURE POWER GRID INITIATIVE

VOLTTRON™: An Intelligent Agent Platform for the Smart Grid

OBJECTIVE

Our energy system is rapidly changing, with digital technology across the grid producing new data streams that offer the potential for in-depth understanding of the energy system. At the same time, integrating renewable energy generation, energy storage, and electric vehicles adds new challenges and opportunities. VOLTTRON™, an innovative distributed control and sensing software platform, makes it possible to build applications which exploit this potential and more efficiently manage energy use among appliances and devices. This new platform was developed through PNNL's Future Power Grid Initiative (FPGI) and is part of FPGI's GridOPTICS™ tool suite.

APPROACH

VOLTTRON™ supports modern control strategies, including the use of agent-based and transaction-based controls. Mobile and stationary software agents perform information gathering, processing, and take control actions. VOLTTRON™ is open source, secure, extensible, modular, and supports a wide range of applications that include:

- Managing end-use loads
- Increasing building efficiency
- Integrating renewable energy
- Accessing storage
- Improving electric vehicle charging.

VOLTTRON™'s capabilities are being expanded to include additional features, such as efficient defrost management and demand response for refrigeration systems, fault detection, demand response and diagnostics for lighting systems, and intelligent prioritization of end-use device selection for curtailment using an analytic hierarchical process.

IMPACT

VOLTTRON™ has been tested and deployed at PNNL as well as other institutions. It has also become the basis for other applications. For example, Virginia Tech is using VOLTTRON™ as the main software platform for their Building Energy Management Open Source Software (BEMOSS). BEMOSS targets small to medium sized commercial buildings and their HVAC and lighting systems. VOLTTRON™ is also currently used by the Lawrence Berkeley and Oak Ridge national laboratories as part of Transactive Network projects funded by the U.S. DOE Office of Energy Efficiency & Renewable Energy (EERE) Building Technologies Office. The deployments at LBNL and ORNL proved VOLTTRON™'s ability to:

Electric vehicles were charged at PNNL's Lab Homes as part of a project that utilized VOLTTRON™ capabilities.

- Automatically and proactively detect faults and diagnose remote terminal units (RTUs) – compliant with California Title 24 requirements – and provide near real-time measurement and verification
- Support demand response applications for RTUs; both time-of-use and critical peak pricing
- Provide condition-based maintenance support for RTUs
- Seamlessly integrate wireless sensors into the transaction network platform

- Temporally match RTU energy consumption and peak photovoltaic generation using forecasting tools and autonomous controller
- Coordinate operations of multiple RTUs in a single building for grid services.

VOLTTRON™ is an open platform that can work with other frameworks and services. It has been publicly released and opened to the community, ensuring it will continue to shape the future of the energy system.

ABOUT GRIDOPTICS™

The Grid Operation and Planning Technology Integrated Capabilities Suite (GridOPTICS™) is the core product of Pacific Northwest National Laboratory's Future Power Grid Initiative, established in 2011. GridOPTICS™ tools are designed to securely collect and manage data in real time, use data to drive modeling and simulation, and convert large volumes of data to actionable information. GridOPTICS™ concepts and tools will show and analyze grid performance at an unprecedented speed, scale, and resolution and will support operational and policy decision-making for the grid of the future. A key emphasis is on transitioning GridOPTICS™ tools to open-source status, supported in their future development and use by a "community" including PNNL, other national labs, academia, vendors, and utilities.

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 more than 4,000 staff, has an annual budget of approximately $1 billion, and has been managed by Ohio-based Battelle since the Lab's inception in 1965.

For more information, please visit the GridOPTICS™ website or contact:

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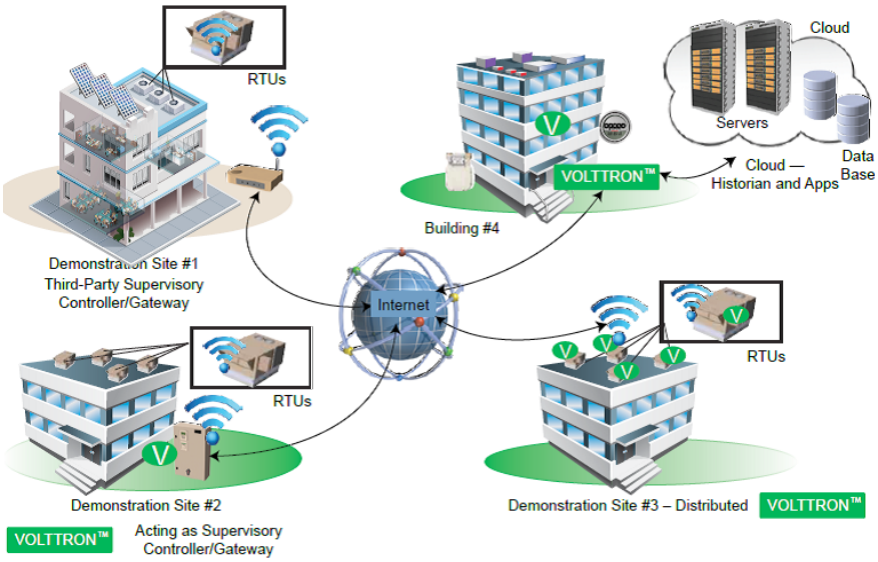

VOLTTRON™ application in the Transactive Network project

VOLTTRON™ is available to the public for download. Visit https://github.com/VOLTTRON/volttron to learn more.

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