

Transactional Network Overview



Improve Operational Efficiency of Building Systems



Manage End-Use Loads



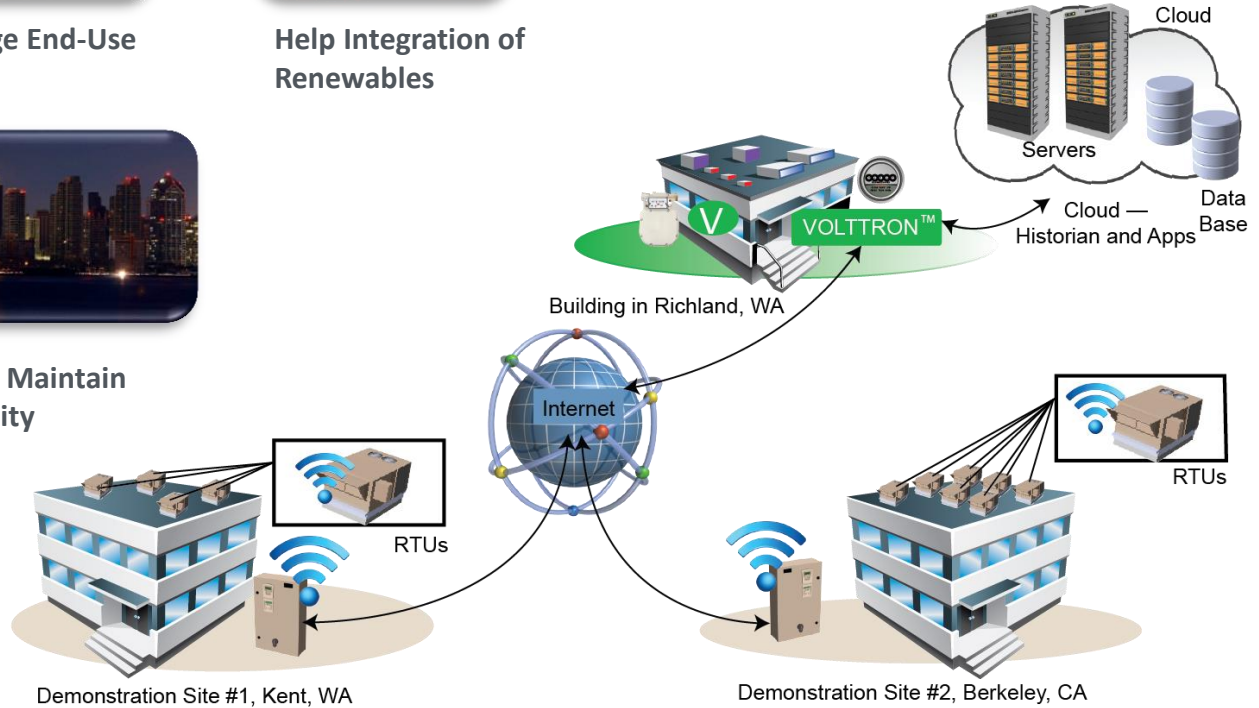
Help Integration of Renewables



Accommodate Millions of Electric Vehicles



Help to Maintain Reliability



Purpose, Objectives and Target Market and Audience

Problem Statement: Operational efficiency of commercial buildings is significantly low; significant penetration of distributed renewable generation and integration of electric vehicles will create challenges; there are number of barriers for exchanging information both within the building and between building and the electric grid cost-effectively; lack of scalable solutions; lack of open and “standard” protocols; lack of near “real-time” measurement and verification process

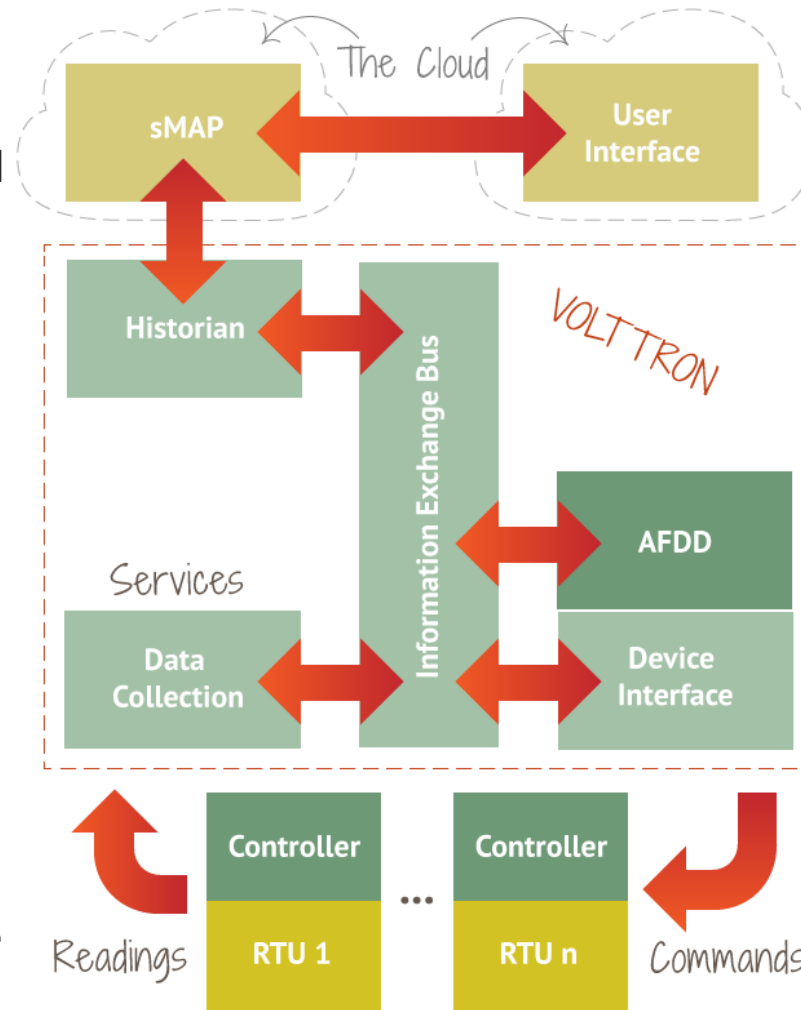
- Leading to significant energy waste and increase in carbon emission
 - Potentially disrupting secure and reliable energy delivery
- This project is the first step in developing, demonstrating and deploying scalable, cost-effective and open solutions

Objective: Develop and deploy transactional network (TN) platform to enable **energy efficiency** and building-grid integration through development, demonstration and propagation of an open source, open architecture platform that enables a variety of site/equipment specific applications to be applied in a cost effective and scalable way

Target Market and Audience: All buildings (commercial and residential) that consume over 40 quads of primary energy. The solutions being developed in this project could also be applied to parts of the industrial sector as well. The audience includes both existing and new energy service providers

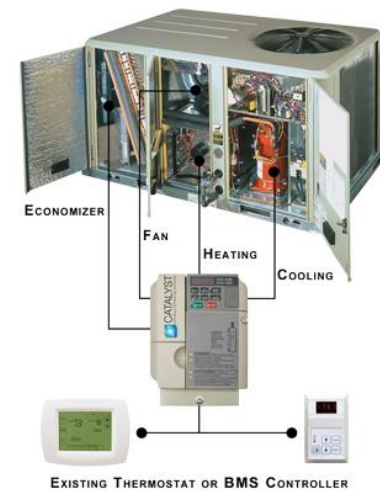
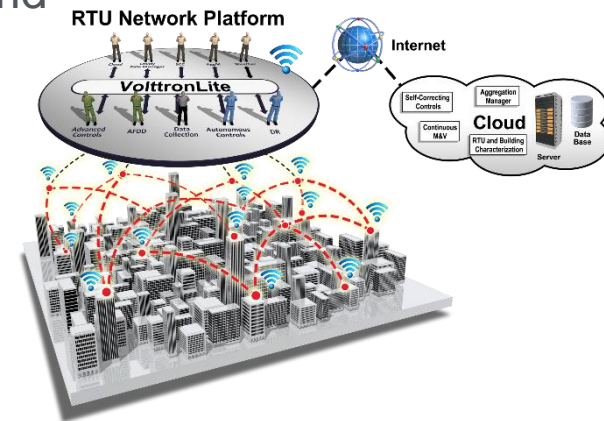
What is the Transactional Network?

- **Transactional network** enables:
 - Interactions among networked systems (e.g., RTUs and other building systems) and the electric power grid
 - software applications on the platform or in the Cloud
- Embedded automated diagnostics and advanced controls on the transactional platform and building systems (e.g., RTU controller)
- Applications running in the Cloud in cases where the transactional platform and controller resources (i.e., processing and storage) are inadequate
- Applications that provide continuous monitoring and verification, automated energy management, etc.



Project Scope and Team

- Enable **transactions** of energy saving solutions, operational improvement solutions AND the transactions between networked systems and the grid to mitigate variable distributed renewable energy sources
- Initially in FY13, the transactional concept was demonstrated using networked rooftop air conditioners and heat pump units (RTUs)
- In FY14, the concept is being extended to monitor and control of **lighting and refrigeration systems**; also extending support to monitor and control any building system connected to **BACnet** (building automation and control network) controllers and coordination on multiple TN nodes
- In the future, it can be extended to homes and network appliances in homes and electric vehicles
- Work is being done at the three national laboratories
 - Pacific Northwest
 - Oak Ridge
 - Lawrence Berkeley



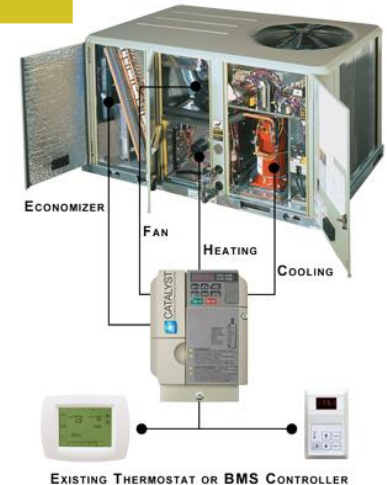
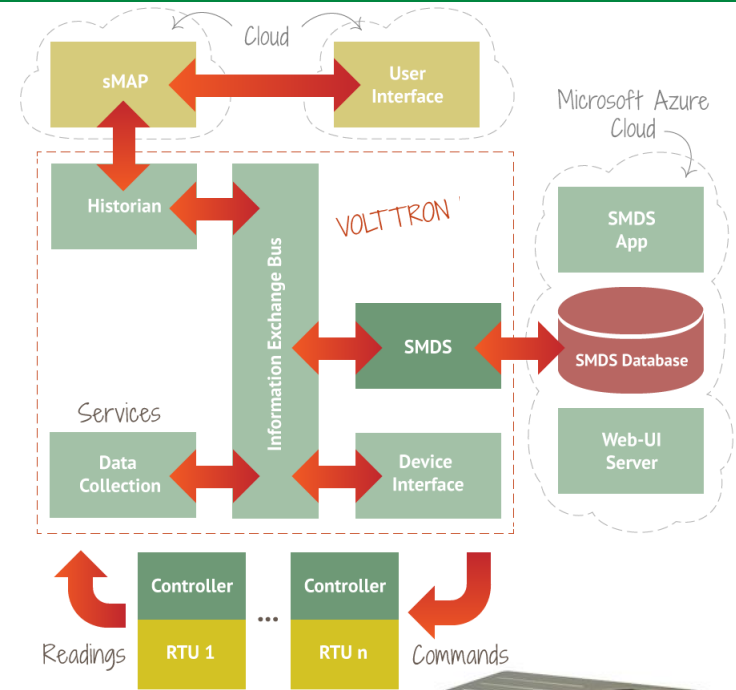
PNNL Transactional Network Applications

Embedded Advanced RTU Controls: Improve operational efficiency of RTUs through use of advanced RTU controls leading to energy and carbon emission reductions over 50%

Demand Response Agent: Make RTUs grid responsive, leading to a more reliable electric power grid and to mitigate variable distributed renewable generation

Automated Fault Detection and Diagnostics:

- Detect economizer and ventilation failures as they occur and notify building operator to correct them
- Refrigerant-side performance degradation (or improvement)
- Energy and cost impacts of the degradation (or improvement)
- Operation schedule changes
- Selected operation faults, such as compressor short cycling, 24/7 operation, system never on, and inadequate ventilation



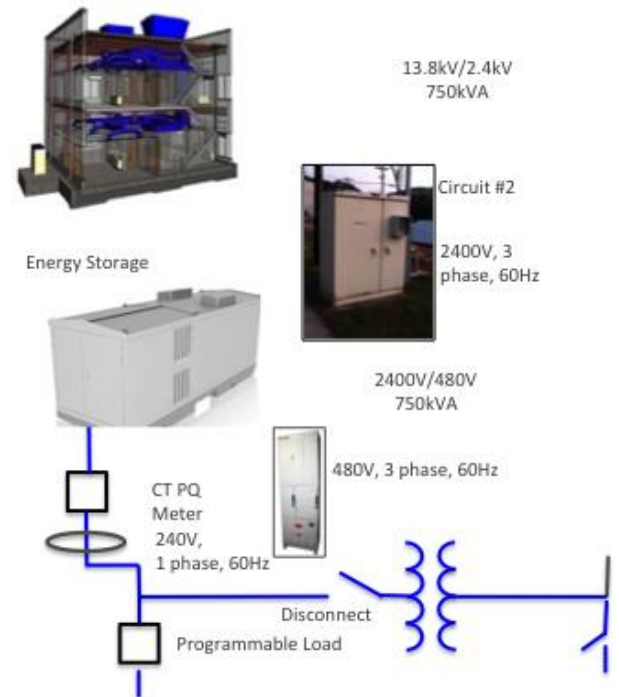
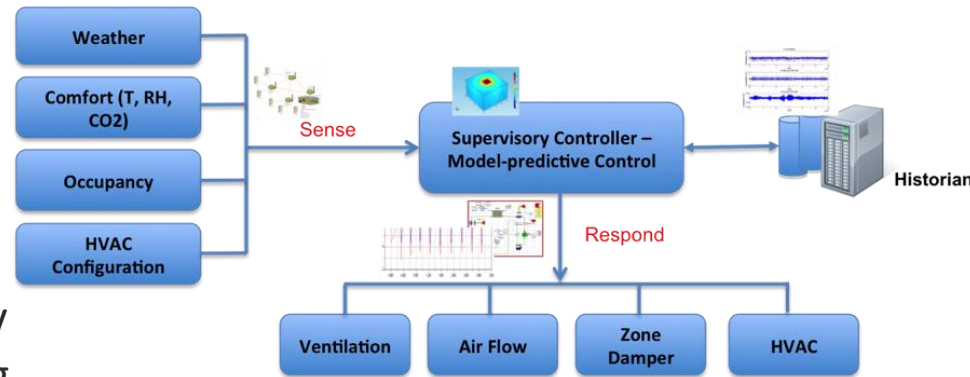
ORNL Transactional Network Applications

Wireless Interoperability Seamless integration of wireless sensors into transaction network platform

Renewable Integration Build autonomous controller to temporally match RTU energy consumption and peak PV generation using forecasting tools

Autonomous Control Build control formulation to orchestrate multiple RTUs with in a single building for a particular grid service (peak reduction, renewable integration) and energy efficiency applications (occupancy, weather forecast)

Super-Market Refrigeration Develop applications (in collaboration with Emerson) to utilize refrigeration systems to provide energy services to grid and improve the energy efficiency of these systems



LBNL Transactional Network Applications

Demand Response Event Scheduler

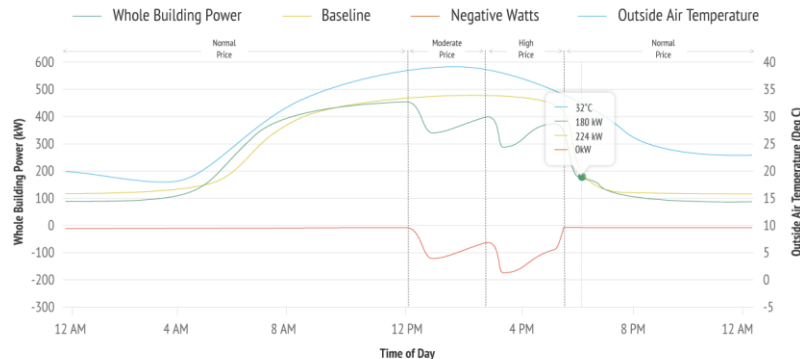
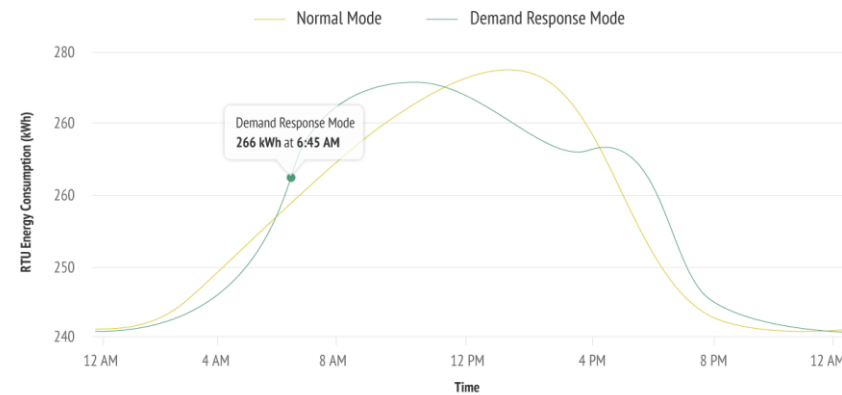
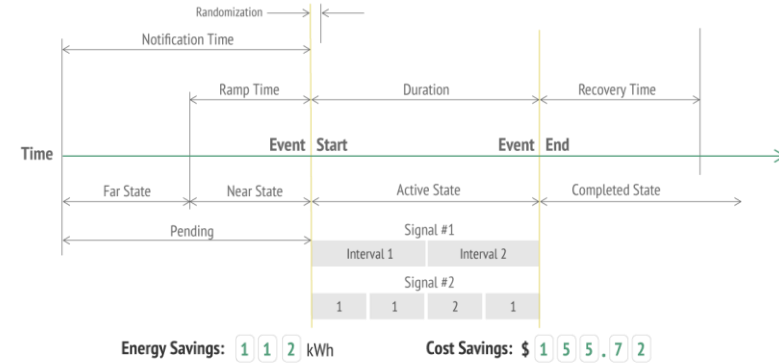
coordinates DR signals from outside server with available network resources

Baseline Load Shape provides basis for measuring change in peak demand and energy use

Demand Response Measurement quantifies change in load for each event

Energy Savings Measurement determines total energy savings benefit over time

Economic Savings Measurement translates results from measurement applications to financial savings (\$)



Next Steps and Future Plans

Next Steps and Future Plans: The first step is to successfully complete the FY14 planned activities that are being conducted at all three labs

- Demonstration of coordination of multiple buildings or TN nodes and BACnet communications
- On-demand defrost cycle implementation on supermarket refrigeration system
- Lighting systems fault detection and diagnostics and controls
- Host a workshop for early adopters in summer
- Draft a plan to create a community with the following goals:
 - Construct and maintain a catalog of real-world transactive network applications related to buildings
 - A reference transactive network platform supported by the community participants
 - Transactive network applications that are developed on the reference transactive network platform for reference and demonstration purposes
 - An interoperability testing and “certification” suite for transactive network applications to ensure broad multi-vendor interoperability
 - Multiple demonstration facilities to help evangelize transactive network applications for buildings