VOLTTRON™ Transactive Control Node

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Panel: Industry Success Stories
Transactive Control (TC)

- A unique distributed control and communication system demonstrated by the Pacific Northwest Smart Grid Demonstration Project (PNW-SGDP)
  - 5 year ARRA funded; ended in 2015
  - Largest demonstration project in the nation ($179M)
  - www.pnwwsmartgrid.org

- Localized power generation/load decisions enabled by
  - Distribution of predicted cost and load schedules
  - Incorporating local information and requirements

- Addresses the following areas:
  - Integration of renewable energy
  - Grid reliability
  - Cost reduction
  - Empowering consumers
Transactive Control Ingredients

Transactive Control Signals

- Communication signals for predicted cost and load
- TIS (Incentive), TFS (feedback)

• Transactive Control Node
  - Uses neighbor signals and local information to generate predicted costs and load
  - Manages local assets (resources and loads)
  - Flexible and efficient design allowing deployment at all levels of the energy hierarchy
  - IBM developed a proprietary node based on IEC 18012 (iCS)
PNW-SGDP: TC Node Framework Specification

TIS/TFS (incentive and feedback signal) calculation and interaction with node neighbors defined by the demonstration project

Computation flow diagram from Transactive Node Toolkit Framework, v 1.0
PNW-SGDP: TC Software Specification

- TC Node objects, configuration and intra-node interactions defined and documented using UML
- Implementation agnostic

Node object diagram from Transactive Control Node: Interactions, Interfaces & Class Structures, v0.90
VOLTTRON™ Reference TC Node

- Designed for research
- Based on the specifications:
  - PNW-SGDP Transactive Node Toolkit Framework, v1.0
  - PNW-SGDP Transactive Control Node: Interactions, Interfaces and Class Structures v 0.90

Resource/Load functions defined for node requirements, communication protocols (i.e. SEP, OpenADR, etc)

TC TIS/TFS computation flow and event management, APIs (toolkit, neighbor, visualization, asset, management)

Services (weather, data collection, management, messaging), agent execution and management, device drivers, security infrastructure
Constrained Feeder 4-Node Demo

Constrained Feeder Node
Modifies forecasted price based on expected load forecasts from home nodes

Home Nodes
- Produces home base load forecast
- Load forecast modified when EV requests charging
- Uses price forecast from feeder and home owner information to manage EV charging

Demonstrates how TIS/TFS and home owner requirements are used to modify EV charging when feeder limits are exceeded.
Demo Node Configurations

**Feeder Node**

Each home node configured for “customer requirements”
VOLTTRON TC Node: Enabling TC User Community

• Provide as open source
  – Enabling important research on Transactive Control
  – Allowing research/customization of load/resource/asset algorithms
  – Development of asset interfaces, emerging smart grid protocols
  – Data analysis/structures become “standardized”

• Technical needs
  – Refinement of TC application and specifications
  – Demonstration of multi-level hierarchy
  – Porting to VOLTTRON 3.0 (system management, data collection, VIP)

• Infrastructure needs
  – GitHub owner/administration and support
  – Test/compliance tools/methods
Thank You and Demonstration
VOLTTRON 2.0 TC Node

Dark green boxes represent TCNode framework agents.

Toolkit Framework Agent is the sequential point of control for Transactive Control functions. All other agents are event-based, asynchronous.