

EPRI Smart Grid Demonstration DER Control Operational Functions Template

March 4, 2010

KCP&L Representative

- Ed Hedges
- Mgr. SmartGrid Technology Planning
- ed.hedges@kcpl.com

Siemens Representative

- Ken Geisler
- Chief Architect, SmartGrid, Energy & Automation
- ken.geisler@siemens.com

EPRI | ELECTRIC POWER RESEARCH INSTITUTE

KC SmartGrid Distributed Resource Management

The DRM Building Blocks

- **DMS - Distribution Management System**
 - Monitors/Controls Real-Time Grid Conditions
- **DRMS – Distributed Resource Management System**
 - Utility Managed Grid Resources (DR & DER)
- **HEMP – Home Energy Management Portal**
 - Consumer Managed Grid Resources (DR & DER)
- **VEMS – Vehicle Energy Management System**
 - Utility Managed PHEV & PEV Resources

EPRI | ELECTRIC POWER RESEARCH INSTITUTE

© 2009 Electric Power Research Institute, Inc. All rights reserved. 2

KC SmartGrid Distributed Resource Management

The DMS Functions

- Monitors and Controls Real-Time Grid Conditions
 - Network grid configuration
 - Critical component operating constraints (capacity, voltage, temp.)
- Predicts “Out of Constraint” Conditions
 - Day-ahead analysis
 - Real-time condition monitoring
- Integrates with DRMS
 - Sends DRMS real-time network topology changes and selected measurements
 - Sends DRMS requests for DR/DER based on predictions
 - Receives from DRMS the current DR/DER potential
- Initiates DMS Managed Load Reductions
 - Distribution Voltage Reduction (DVR)
 - Performs contingency switching

KC SmartGrid Distributed Resource Management

The DRMS Functions

- Manage Utility DR/DER Resources
 - Enroll resources and track program availability
 - Initiate DR/DER calls and schedules
- Aggregate/Disaggregate DR/DER Resources
 - Network Topology – PTxfmr, lateral, feeder, substation, system
 - Real-time topology updates from DMS
 - Communicate DR/DER resource availability and cost to DMS & Mkt Traders
- Receive Demand Reduction Calls and Schedules
 - Market traders for economic dispatch
 - RTO Operators for transmission grid congestion
 - DMS for Distribution grid congestion
- Wholesale to Retail Price Transformation
 - Receive wholesale pricing
 - Transform to utility distribution grid pricing
 - Transform to retail program pricing

KC SmartGrid Distributed Resource Management

The H-EMP Functions

- Functions as a DR Aggregator Integrated with DRMS
- Flexible Whole Home Energy Monitoring Capabilities
 - Historical TOU and real-time usage and cost data
 - Energy usage comparisons to “neighbors”
 - Requires Broadband in the home w/optional cell phone apps.
- Helpful Hints on energy efficiency and management
 - Analyze Impacts of appliance upgrades
 - Analysis of various rate options and tips for reducing bills
- Appliance Monitoring and Energy Management Functions
 - Easy ‘Set it and forget it’ configuration.
 - Supports appliance control modules and future ‘SmartAppliances’
 - Supports TOU, day-ahead and real-time pricing, and DR tariffs
- Integrates with and Manage In-Home DER (solar, wind, battery, etc.)
- Provide Integrated User Experiences
 - Transparent access via utility (AccountLink) consumer portal
 - In-Home integration with home device, security, and entertainment automation

KC SmartGrid Distributed Resource Management

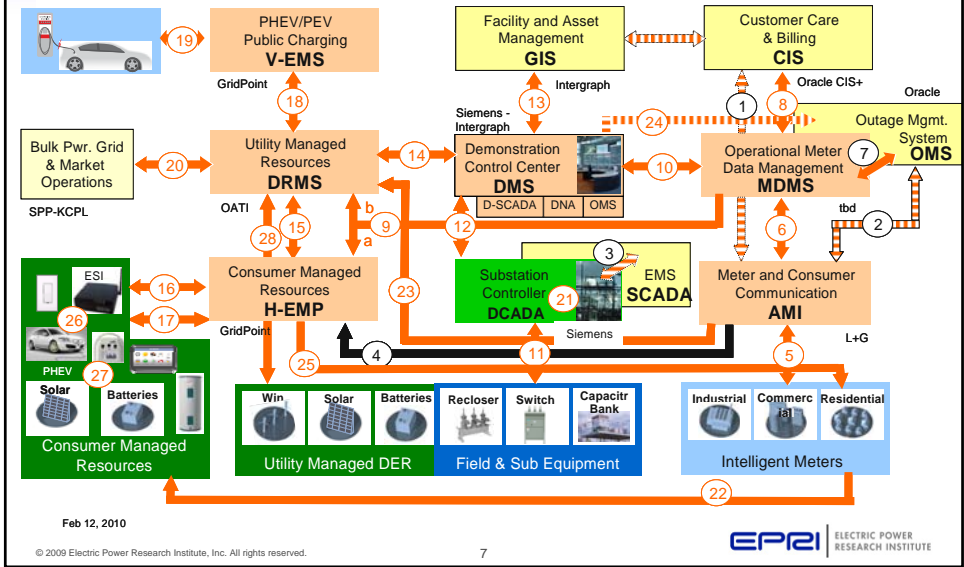
The V-EMS Functions

- Enroll PHEV/PEV resources and track program availability
- Track current grid connection location and charging status
- Manages charging TOD, duration, etc. based on consumer/site tariff and grid conditions.
- Initially functions as a DR Aggregator Integrated with DRMS

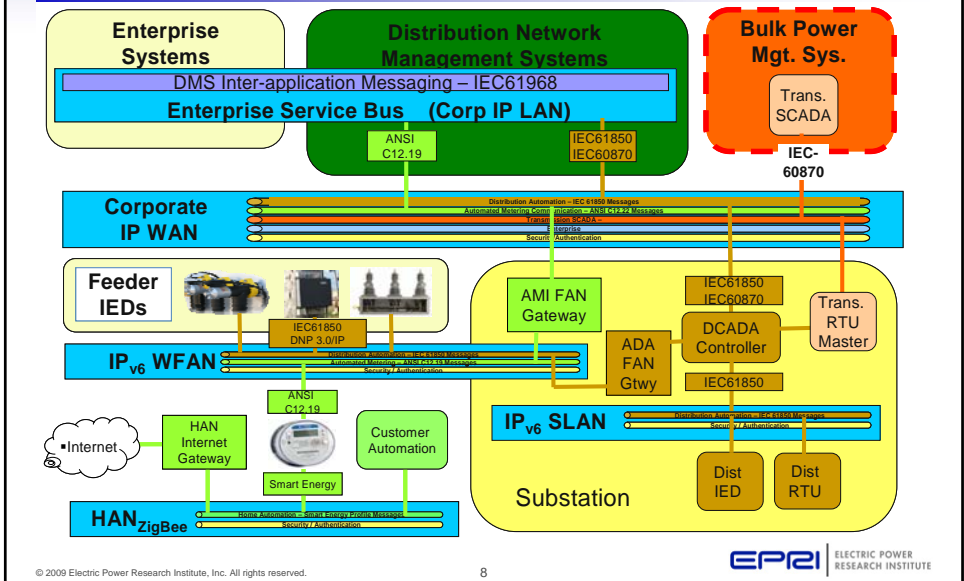
Many of the following functions are still conceptual and will be determined in conjunction with Industry and NIST initiatives.

- Communicate with vehicle with price information
- Communicate charge information to utility billing system or industry clearinghouse
- Respond to DER calls from DRMS

KCP&L SmartGrid Demonstration – Systems Integration



KCP&L SmartGrid Demonstration – Communication Infrastructure



Interoperability Standards & Protocols

- Focused on NIST Interoperability Standards

- Back Office Systems Integration
 - IEC 61968 Standards
 - OpenADR (DRMS w/ H-EMP & V-EMS)
 - IBM WebSphere Enterprise Integration Bus
- Distributed-Hierarchical Control Infrastructure
 - IEC 61850 Standards
 - IPv6 WAN Network
- Distribution Substation Automation
 - IEC 61850 Standards
 - IPv6 Substation LAN
- Utility Grid and DER Monitoring & Control
 - IEC 61850 Standards (DNP 3/IP)
 - IPv6 via proprietary 900Mhz Mesh FAN

Interoperability Standards & Protocols

- Incorporate Emerging work from NIST PAPs

- Meter Reading and Alerts
 - ANSI C12.19
 - Proprietary via 900Mhz Mesh FAN
- Residential HAN Automation & DR
 - Smart Energy Profile v1.5
 - ZigBee
- Commercial Building Automation/EMS
 - Open ADR (DRMS to C-EMS)
 - BacNet but may vary by installation
- DR Signals & Interoperability
 - NAESB Standards
 - tbd OASIS Standard (OpenADR 2.0 ?)
- PEV Integration
 - tbd

Utility Benefit Categories

Capital Cost Management

- Deferred transmission and distribution capacity investments
- Reduced generation capacity costs from improved asset utilization
- Reduced equipment failures due to overloads

O&M Cost Management

- Reduced transmission congestion costs
- Reduced meter reading & field service costs
- Reduced theft, diversion, and other write-offs
- Reduced T&D losses and kWhrs generated

Customer Satisfaction

- Improved Reliability
- Improved Quality of Service

Environmental

- Reduced consumption of natural resources
- Reduced CO₂, NO_x and other pollutants emitted

Consumer Benefit Categories

Energy Cost Management

- Energy price increase restraint due to utility cost savings
- Ability to manage personal energy consumption to minimize cost
- More pricing/payment alternatives offered

Continuity of Service

- Reduced number of outages
- Duration of outages is reduced
- Better communications regarding service restorations

Quality of Service

- More service offerings aligned with consumer preferences
- Improved voltage profiles

Environmental

- Ability to integrate renewable generation and storage.
- Reduced utility consumption of natural resources
- Reduced utility CO₂, NO_x and other pollutants emitted

Gaps / Challenges

Technical

- Maturity and Gaps in the NIST Interoperability Framework Standards
- Evolving Smart Grid Cyber Security requirements
- Availability of field devices to support desired standards

Workforce Resourcing & Acceptance

- Changing the engineering status quo
- Virtual operating district for the demonstration area
- Overcoming the “is the SmartGrid for Real?” question.

Customer Education & Acceptance

- Green Impact Zone has unique urban neighborhood challenges
- Lack of disposable income and focus on “reduce my bill”

Political/Regulatory

- Managing Green Impact Zone project expectations
- DOE oversight & ARRA reporting
- Commission staff participation

Questions?

