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
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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

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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
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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

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
**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

- **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, NOX 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, NOX 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?