Smart Grid Update

ENERGY STAR Monthly Partner Meeting

Call in number: 866 299 3188

Conference Code: 202 343 9965#

About The Web Conferences

- Monthly
- Topics are structured on a strategic approach to energy management
- Help you continually improve energy performance
- Opportunity to share ideas with others
- Slides are a starting point for discussion
- Open & interactive

Web Conference Tips

- Mute – To improve sound quality, all phones will be muted.
  - Use # 6 to un-mute
  - * 6 to mute

- Presentation slides will be sent by email to all participants following the web conference.

The Smart Grid

What is it?

What is the status of implementation?

What does it mean for energy managers?

Today's Web Conference

Smart Grid Update:

- **Christopher Irwin - Department of Energy**
- **David Holmberg - National Institute of Standards and Technology**

U.S. Department of Energy

Office of Electricity Delivery and Energy Reliability

Understanding the Smart Grid

Christopher Irwin
Smart Grid Standards and Interoperability Coordinator
Office of Electricity Delivery and Energy Reliability

A “Promising” Application

- A Building Energy Management System that integrates smart meter data and rooftop solar arrays into an IP-based, secure solution, greening facility power and earning Renewable Energy Credits. Servers in a LEED Gold certified data center connect directly with energy markets and your electric utility, enabling you to participate in energy and money saving programs like demand response, voluntary load shedding programs, and the open market.

Smart Grid Characteristics

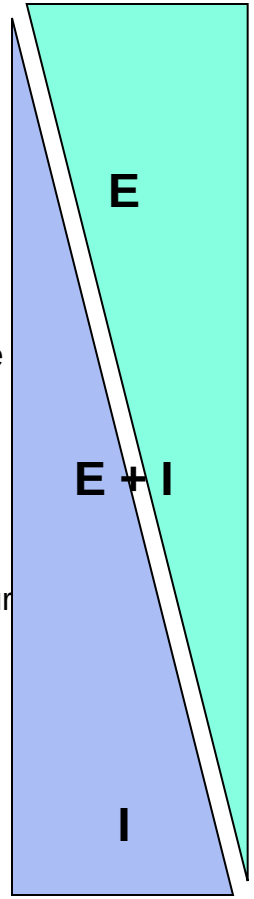
- **Empowers the consumer**: Consumer choices and increased interaction with the grid bring tangible benefits to both the grid and the environment, while reducing the cost of delivered electricity.
- **Enables markets**: The grid's open-access market reveals waste and inefficiency and helps drive them out of the system while offering new consumer choices such as green power products. Reduced transmission congestion leads to more efficient electricity markets.
- **Accommodates all generation and storage options**: Diverse resources with "plug-and-play" connections multiply the options for electrical generation and storage including new opportunities for more efficient, cleaner power production.
- **Self-heals:** The modern grid will perform continuous self-assessments to detect, analyze, respond to, and as needed, restore grid components or network sections.
- **Resists attack**: The grid deters or withstands physical or cyber attack and improves public safety.
- **Provides power quality for 21st century needs**: Digital grade power quality avoids productivity losses of downtime, especially in digital device environments.
- **Optimizes assets and operates efficiently**: Desired functionality at minimum cost guides operations and fuller utilization of assets. More targeted and efficient grid maintenance programs result in fewer equipment failures.

Why does a Smart Grid matter?

- The Smart Grid is an operating system for energy applications. In many smart building applications, like demand response, distributed wind and solar, and electric vehicles support, a Smart Grid paves the way for dramatically better opportunities.
- There are over 3000 electric utilities deciding what, how, and when to upgrade, and you have to know your OS to know what is possible.

Top-level Conceptual Framework: "GWAC Stack"

Organizational (Pragmatics)	8: Economic/Regulatory Policy	Political and Economic Objectives as Embodied in Policy and Regulation
	7: Business Objectives	Strategic and Tactical Objectives Shared between Businesses
	6: Business Procedures	Alignment between Operational Business Processes and Procedures
Informational (Semantics)	5: Business Context	Relevant Business Knowledge that Applies Semantics with Process Workflow
	4: Semantic Understanding	Understanding of Concepts Contained in the Message Data Structures
Technical (Syntax)	3: Syntactic Interoperability	Understanding of Data Structur In Messages Exchanged between Systems
	2: Network Interoperability	Exchange Messages between Systems across a Variety of Networks
	1: Basic Connectivity	Mechanism to Establish Physical and Logical Connectivity of Systems



A “Promising” Application

- A Building Energy Management System (5) that integrates smart meter data (1,2,3,4) and rooftop solar arrays into an IP-based (2), secure (1-8) solution, greening facility power and earning Renewable Energy Credits (8). Servers in a LEED Gold certified data center connect directly with energy markets (7) and your electric utility (2,3,4,5), enabling you to participate in energy and money saving programs like demand response (6,7), voluntary load shedding programs (5,6,7), and the open market (7).

For a Smart Grid, a Smart Building is…

- A Responsive Building, capable of reacting to market opportunities and system needs with very low latency.
- A Flexible Building, able to anticipate its needs and shape consumption and demand.
- A Measured Building, able to provide actionable information to occupants and confirm grid responsive behavior.

Honeywell AutoDR Project

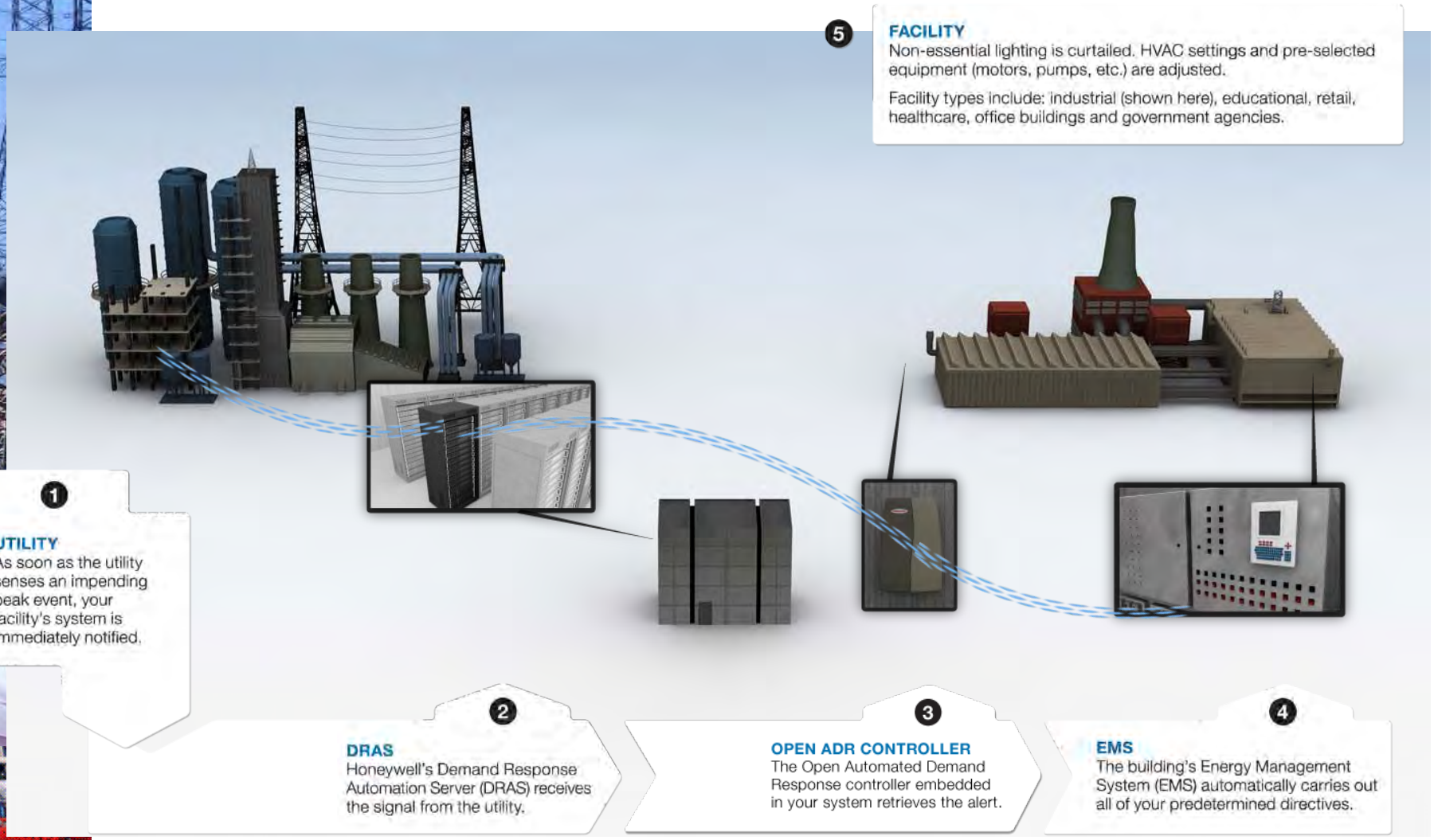
- **Recipient**: Honeywell International, Inc.
- **Total Budget**: $22,768,726
- **Federal Share**: $11,384,363
- **Project Type**: Customer Systems

- **Equipment:** Up to 241 Energy Management Systems

- **Targeted Benefits**
- Reduced Electricity Cost for Customers
- Reduced Operating and Maintenance Costs
- Deferred Investment in Generation
- Reduced Greenhouse Gas Emissions

- http://www.smartgrid.gov/sites/default/files/09-0286-honeywell-ems-description-02-04-11.pdf

How Auto DR from Honeywell Works



Customer Success Story – Distribution Center

- **Challenges Addressed**
  - Save money and reduce energy costs during Peak Pricing events
  - Automate existing manual shed measures to improve shed response reliability while reducing impact on customer's facility management team
- **Solution**
  - Installed Comfort Point Building Automation System to perform the following functions:
    - Shut off exhaust fans in production areas during non-production hours (6 kW)
    - Control lighting in production areas during non-production hours (48 kW)
    - Move battery charging of forklifts to off-hours during peak events (38 kW)
    - Raise global temperature during peak events (32 kW)
- **Benefits**
  - Customer saves ~$8,000 in energy costs during Summer Peak energy season
  - Customer saves ~$3,000 year-round in energy costs due to moving battery charging to lower tariff price window (8pm-8am)
  - Automation controls eliminate dependency on human intervention to initiate energy reduction

Tallahassee Project

- **Recipient**: City of Tallahassee
- **Total Budget**: $17,781,108
- **Federal Share**: $8,890,554
- **Project Type**: Customer Systems

- **Equipment**
- Up to 15,000 Programmable Communicating Thermostats
- Direct Load Control Devices for 100 Sites
- Customer System Communication Systems
- Distribution System Upgrade/Automation
- Communications Equipment/SCADA
- Automated Feeder Switches
- Automated Reclosers
- Capacitor Automation Equipment
- Regulator Automation Equipment

- **Targeted Benefits**
- Reduced Customer Electricity Costs
- Improved Electric Service Reliability and Power Quality
- Reduced Ancillary Services Costs
- Reduced Congestion Costs
- Reduced Costs from Equipment Failures
- Reduced Greenhouse Gas and Criteria Pollutant Emissions

http://www.smartgrid.gov/sites/default/files/09-02640-city-of-tallahassee-project-description-02-21-11.pdf

Building on a Smart Grid Foundation

Talgov.com
CITY of TALLAHASSEE

SAVE ENERGY SAVE WATER SAVE MONEY
City of Tallahassee
Your Own Utilities

Residents | Businesses | Government | Visitors | Students | Your Own Utilities | E-Services

Featured Services

- Transactions
- Requests
- Interactive Information
- Departments

Other Your Own Utilities Areas

- Your Own Utilities Home
- Your Account
- Your Home
- Your Business
- Our Community
- About "YOU"
- Utility Online Services

Contact Us

Utility Customer Service
Renaissance Center
435 North Macomb St.

The e+ Smart Grid

Imagine a future where you have more control of your utility use and where you will be able to more easily save energy, save water and save money. Imagine that your utility meters will be accurately read daily or on demand, and without sending trucks and staff into the field. Imagine that we'll be able to remotely pinpoint electric outages and water leaks allowing more efficient, quicker repair.

The City of Tallahassee and Your Own Utilities are dedicated to providing innovative ways to protect and enhance the quality of life in our community and to provide the best customer service possible. Part of this commitment is the the City of Tallahassee Utility's ***Smart Grid Project.***

The Smart Grid - What is it?

The smart grid is a term used to described the modernization of the electric grid infrastructure to;

- Significantly improve the efficient production and distribution of power to customers
- Allow utility customers to play a bigger role in how and when they use power

The City of Tallahassee Utilities' **e+ SmartGrid** takes this concept further by providing a three-tier system of electric, natural gas and water smart grids for our customers.

Smart Meters – What are they?

Related

Nights
Electric

How to
Smart

Share

Opportunities Expand

GridSense and On-Ramp Wireless Partner to Develop Wireless Smart Transformer Monitoring -- GridSense has …first affordable utility distribution point monitoring system. The comprehensive system …(1) asset monitoring, (2) fault indication to improve outage restoration, (3) to provide alerts to power quality issues, (4) to capture power thefts, and (5) to act as a hub for demand-side load management -- all with a single wireless device.

Energy Alchemy: Turning Building Energy Use Into a Potential Profit Center -- Most developers view electricity and other utility costs as a liability, a cost of doing business in real estate. This does not have to be the case. Green building law specialist and attorney Shari Shapiro outlines four major opportunities to turn energy into gold: energy efficiency; energy choice; demand management; and on-site renewable energy production.

Demand Resources and Energy Efficiency Continue to Grow in PJM's RPM Auction -- Renewable resources, including demand response and energy efficiency, made up nearly 68 percent of the new capacity available and about 10 percent of the resources clearing PJM Interconnection's recently completed capacity auction. PJM has announced the results of its Reliability Pricing Model (RPM) capacity auction for resources to meet customers' electric power demand in the June 1, 2014 to May 31, 2015 delivery year.

Northwest Power Surplus May Halt Wind Energy -- The manager of most of the electricity in the Pacific Northwest is running such a surplus of power from hydroelectric dams that it put wind farms on notice Friday that they may be shut down as early as this weekend. The agency has announced …The capacity of power grids has not kept pace.

City of McKinney Plugs in First Electric Vehicle to City Owned Charging Network -- The Texas city of McKinney's first electric vehicle (EV) plugs into its very own EV charging station last week at the city's Roy and Helen Hall Library downtown provided through the TXU Energy EV Accelerator Program(SM). This station is one of the city's four planned charging stations.

Contact Information

Christopher Irwin
Office of Electricity Delivery and Energy Reliability
U.S. Department of Energy
christopher.irwin@hq.doe.gov

For more Smart Grid Information:

OE: www.oe.energy.gov

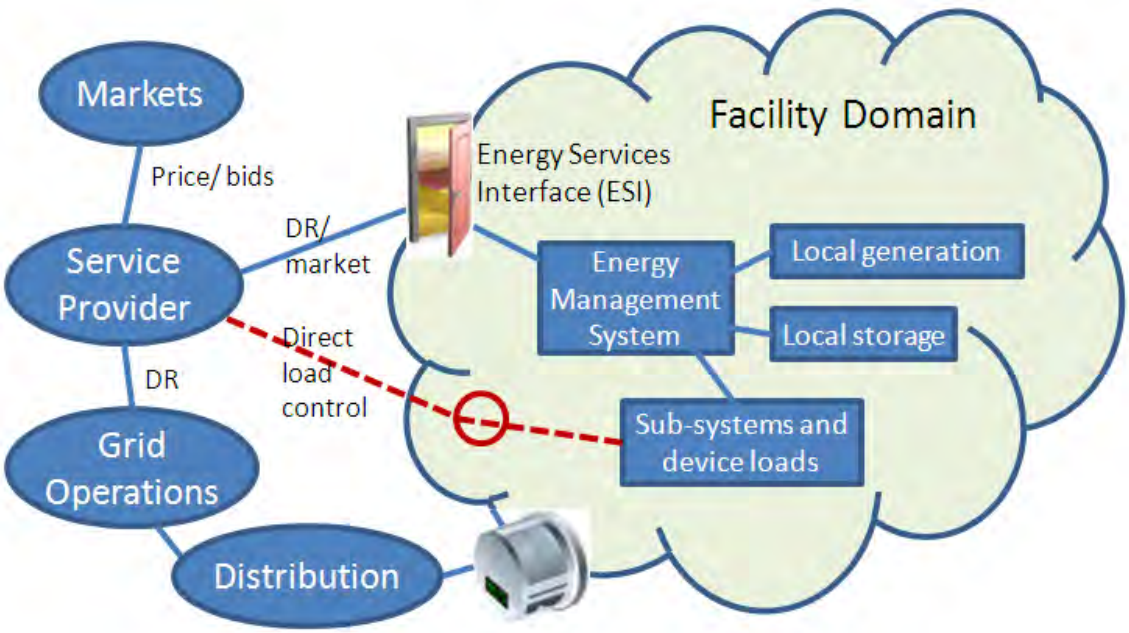
Smart Grid: www.smartgrid.gov

Smart Grid Task Force: www.oe.energy.gov/smartgrid_taskforce.htm

Smart Grid standards and new opportunities

David Holmberg
NIST Engineering Lab

Smart Grid and Energy Management

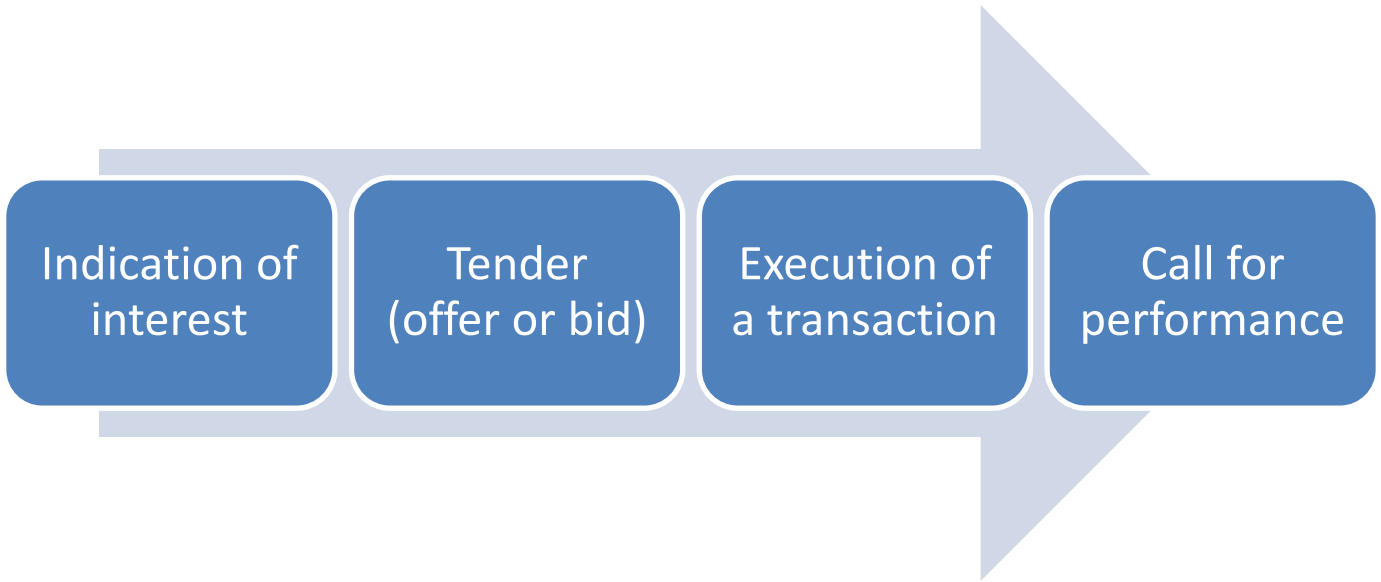


- Smart Grid is about the facility supporting the grid while sharing economic benefits.
- Facility EMS manages energy resources to meet energy goals
- ESI is service oriented door to facility

SG opportunities for facility managers

- New markets and service offerings:
  - Real-time prices (low night prices, higher peaks)
  - Demand response (DR) programs, including at the wholesale level (bidding “negawatts” to market)
  - ancillary services: voltage regulation, fast DR, phase adjustment
  - Selling power to aggregators or direct to market
  - service opportunities for you such as provision of weather data, forward load estimates, DER status.

How do energy markets function today?



- If you participate in energy markets, how do you accomplish each of these steps for a given market and market product?
- Does a single interface serve for all functions?
- If you have multiple systems in different regions, do you have the same interactions in these different regions?
- A new standard due out soon---OASIS Energy Interoperation addresses each of these and will hopefully lead to streamlined and consistent market participation, and consistent interfaces.

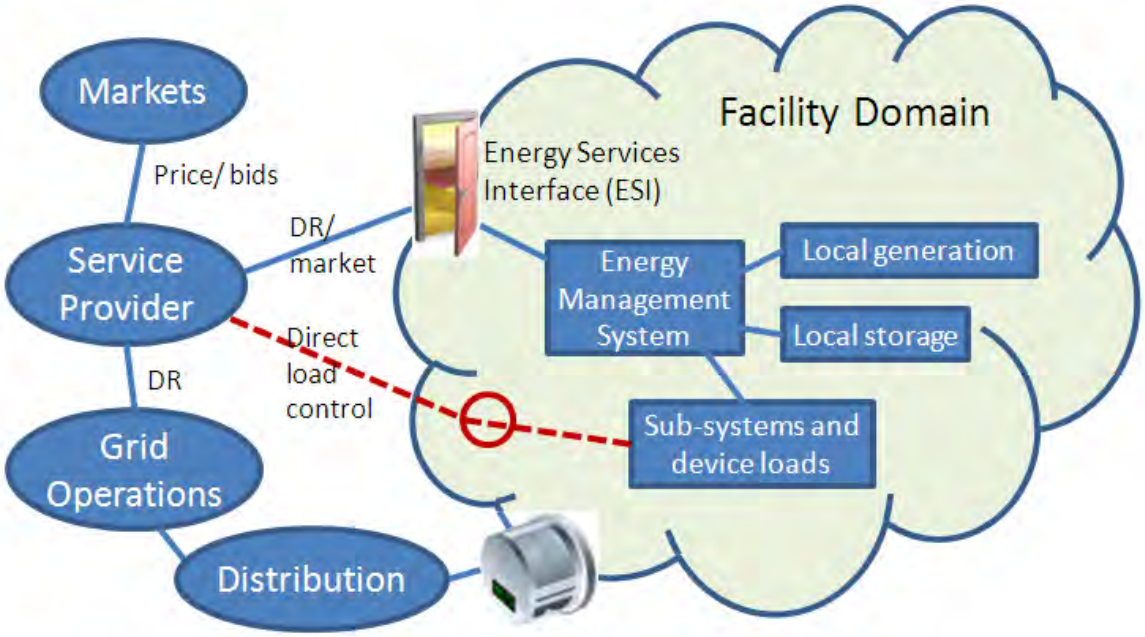
OASIS Energy Interoperation (EI)

- Version 1.0 due out this summer.
- Handles market interactions, and also includes DR signaling (events).
- Has rich scheduling features to allow setting constraints on participation in events, or for scheduling market participation.
- References the Energy Market Information Exchange standard (EMIX) for price and product communication, and the WS-Calendar standard for scheduling.

ISO and utility use of EI

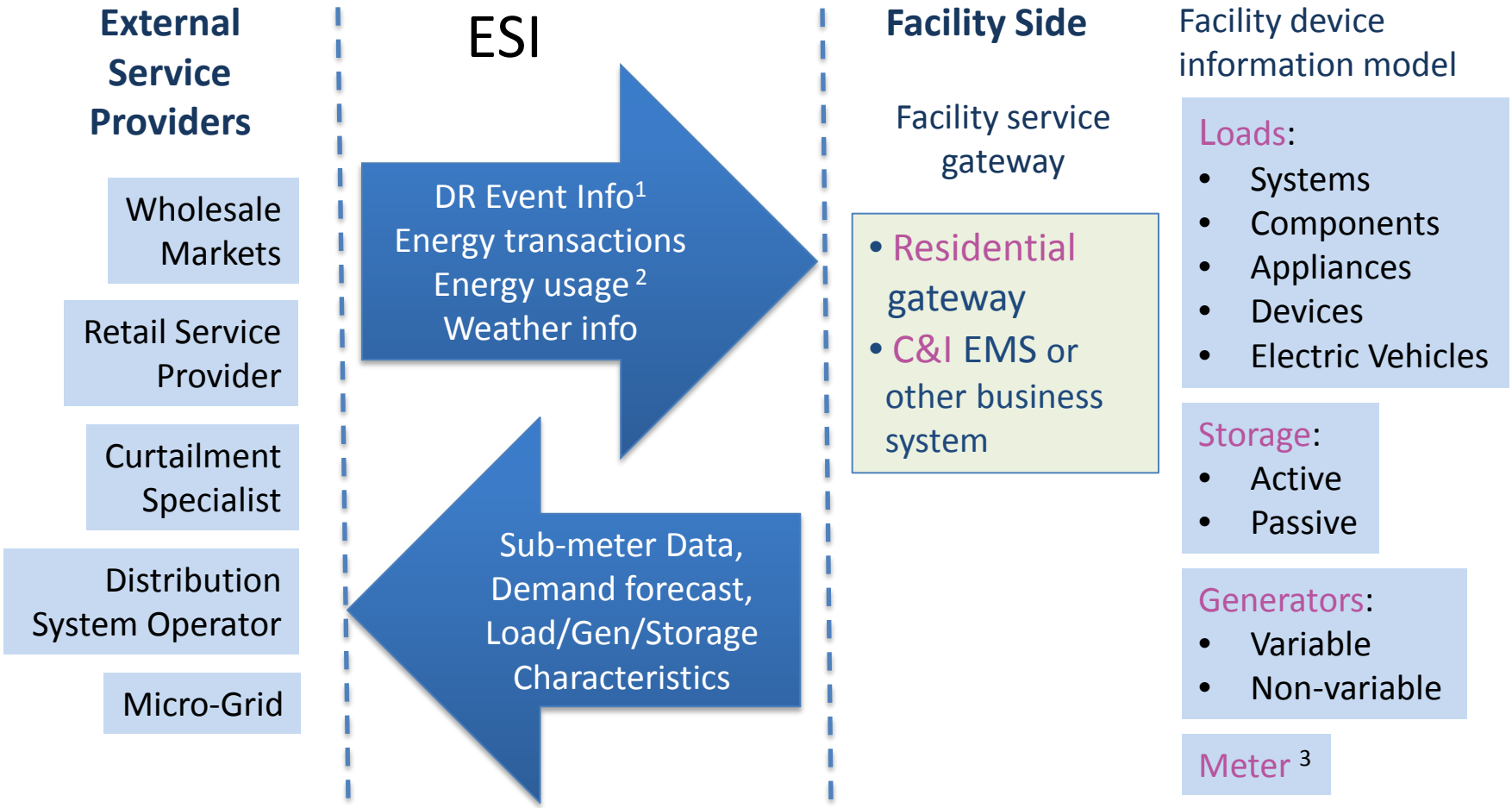
- OpenADR version 1.0 (out of LBL) is used in CA for DR. OpenADR 2.0 is a profile on OASIS EI.
- Utility industry OpenADR Task Force has been engaged in the Energy Interoperation development.
- (also have had participation by ISO/RTO Council to address wholesale market requirements)
- OpenADR is supported by the OpenADR Alliance:
  - protocol testing
  - conformance test development
  - product interoperability tests
  - planning for product releases by the end of the year.
- Utilities are looking at EI not just for DR but also price distribution
- ISOs also are looking at integrating EI into their market communications and DR resource dispatch.

Energy Services Interface (ESI)



- Energy Interoperation is a service oriented protocol for communications at the ESI.
- So your facility can interact in a standard way with multiple service providers.
- Other protocols serve inside the facility domain

ESI Interface



[1] DR event notification, start time, duration, shed level/ price, bid acceptance

[2] Energy usage, per NAESB EUI standard provides validated meter data from utility back end.

[3] The meter shown here in the facility domain is a sub-meter. The utility revenue meter may also provide data to the facility owner using the facility meter data model.

*Note: direct control is not via a high-level service interface.

Smart Grid Interoperability Panel

- Public-private partnership created in Nov. 2009
- 664 member organizations
- Open, public process with international participation
- Coordinates standards developed by Standards Development Organizations (SDOs)
  - Identifies Requirements
  - Prioritizes standards development programs
  - Works with over 20 SDOs including IEC, ISO, ITU, IEEE, …
- Web-based participation (via link from www.nist.gov/smartgrid)

Smart Grid Stakeholders

- Federal Government
  - White House, DOE, FERC, DHS, FCC, EPA, USDA, …
- State and Local Government
  - State PUCs, NARUC
- Electric Utilities
  - Investor-owned utilities, Municipals, Rural Cooperatives
- Market makers, Aggregators and other market intermediaries.
- Equipment and System Providers
  - Traditional electric suppliers, IT, telecom, building automation, …
- Consumers (residential, commercial, industrial, institutional)
- Universities and Research Institutes
- Standards Setting Organizations (nearly 30)
- Other countries developing smart grids (dozens)

Gaps in Standards Being Addressed by PAPs

Priority Action Plan	Standard(s) or Guideline(s)
PAP 0 - Meter Upgradeability Standard	NEMA Meter Upgradability Standard: SG-AMI 1-2009
PAP 1 - Role of IP in the Smart Grid	Informational IETF RFC
PAP 2 - Wireless Communications for the Smart Grid	IEEE 802.x, 3GPP, 3GPP2, ATIS, TIA
PAP 3 - Common Price Communication Model	OASIS EMIX, ZigBee SEP 2, NAESB
PAP 4 - Common Scheduling Mechanism	OASIS WS-Calendar
PAP 5 - Standard Meter Data Profiles	AEIC V2.0 Meter Guidelines (addressing use of ANSI C12)
PAP 6 - Common Semantic Model for Meter Data Tables	ANSI C12.19-2008, MultiSpeak V4, IEC 61968-9
PAP 7 - Electric Storage Interconnection Guidelines	IEEE 1547.4, IEEE 1547.7, IEEE 1547.8, IEC 61850-7-420, ZigBee SEP 2
PAP 8 - CIM for Distribution Grid Management	IEC 61850-7-420, IEC 61968-3-9, IEC 61968-13,14, MultiSpeak V4, IEEE 1547
PAP 9 - Standard DR and DER Signals	NAESB WEQ015, OASIS EMIX, OpenADR, ZigBee SEP 2
PAP 10 - Standard Energy Usage Information	NAESB Energy Usage Information, OpenADE, ZigBee SEP 2, IEC 61968-9, ASHRAE SPC 201P
PAP 11 - Common Object Models for Electric Transportation	ZigBee SEP 2, SAE J1772, SAE J2836/1-3 , SAE J2847/1-3, ISO/IEC 15118-1,3, SAE J2931, IEEE P2030-2, IEC 62196
PAP 12 - IEC 61850 Objects/DNP3 Mapping	IEEE Std 1815 (DNP3); IEEE P1815.1 (plus anticipated dual logo with the IEC)
PAP 13 - Time Synchronization, IEC 61850 Objects/IEEE C37.118 Harmonization	IEEE PC37.238; IEEE C37.118.1; IEEE C38.118.2; IEC 61850-90-5 (plus anticipated dual logo with the IEEE)
PAP 14 - Transmission and Distribution Power Systems Model Mapping	IEC 61968-3, MultiSpeak V4
PAP 15 - Harmonize Power Line Carrier Standards for Appliance Communications in the Home	DNP3 (IEEE 1815), HomePlug AV, HomePlug C&C, IEEE P1901 and P1901.2, ISO/IEC 12139-1, G.9960 (G.hn/PHY), G.9961 (G.hn/DLL), G.9972 (G.cx), G.hnem, ISO/IEC 14908-3, ISO/IEC 14543, EN 50065-1
PAP 16 - Wind Plant Communications	IEC 61400-25
PAP 17 - Facility Smart Grid Information Standard	New Facility Smart Grid Information Standard ASHRAE SPC 201P
PAP 18 - SEP 1.x to SEP 2 Transition and Coexistence	TBD – Guidelines and/or best practices

Thanks!

David Holmberg
david.holmberg@nist.gov
301-975-6450

- Questions & Comments
  - # 6 to un-mute phone
  - * 6 to mute

Upcoming Web Conferences

June – Cool Energy Savings

July – Best Practice & Project Replication Strategies

August – Our Top 3 Energy Projects

Register online at: energystar.webex.com/meetings

Thank you!