IBM Global Energy & Utilities Industry



The Olympic Peninsula Project

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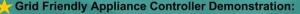


Pacific NW GridWise™ Testbed Projects Unleashing the power of distributed resources

Summary of Projects

Olympic Peninsula Demand Response Demonstration:

- Integrating in-the-field demand response and backup generators in a virtual operating environment
- Experimenting to relieve transmission and distribution congestion during peak periods.



- Equipping 150 homes in Washington and Oregon with Grid Friendly appliance controllers on water heaters and clothes dryers.
- Testing ability to automatically red to stress on the grid.

Project Objectives

- · Illustrate how the transformed power GridWise will function and explore
- · Demonstrate how transmission and investment can be deferred
- Define the role demand response of





Olympic Pe



Who Benefits from GridWise? **Bonneville Power Administration**

- Reduce constraints on transmission grid
- · Provide ancillary services that increase reliability and minimize outage size and duration.
- Optimize cost-effectiveness by minimizing power purchases and maximizing power sales to regional wholesale market

Local utilities

Pacific NW GridWise Testbed Participants

Pacific NW National Lab U.S. Dept of Energy **Bonneville Power Administration** Invensys Preston Michie Associates Pacificorp Portland General Electric Dr. Lynne Kiesling, IFREE **IBM**

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GRÍDWISE

Whirlpool/Sears

Mason County PUD #3

Clallam County PUD #1

Pacific Northwest National Laboratory Operated by Battelle for the U.S. Department of Energy

Smart Grid for Smart Cities – NYU Wagner – February 3, 2010



Environment

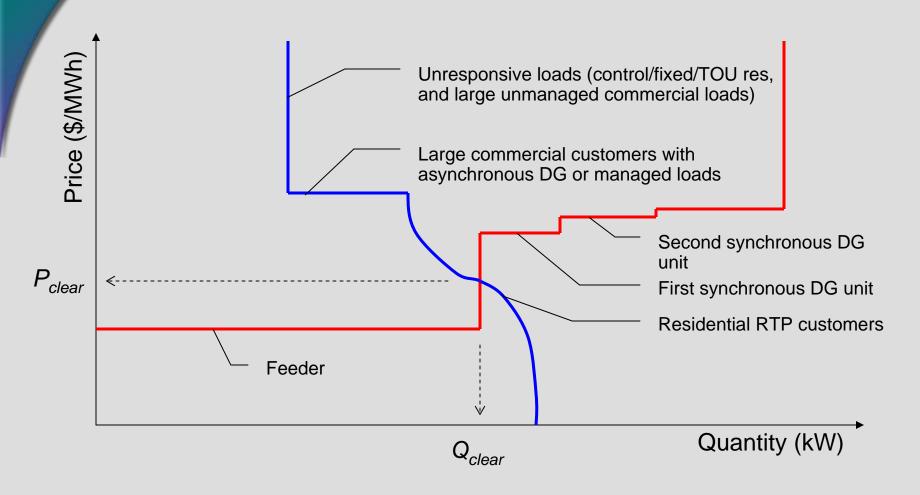
- Integrate multiple commercial and residential assets
 - Distributed Generation (DG)
 - Aggregated DG across several commercial sites
 - ✓ Individual dispatchable DG
 - Demand Response (DR)
 - Residential and Commercial Demand Response assets
 - ✓ Direct load control
 - Residential customer signals to encourage usage change



Shadow Real-Time Market

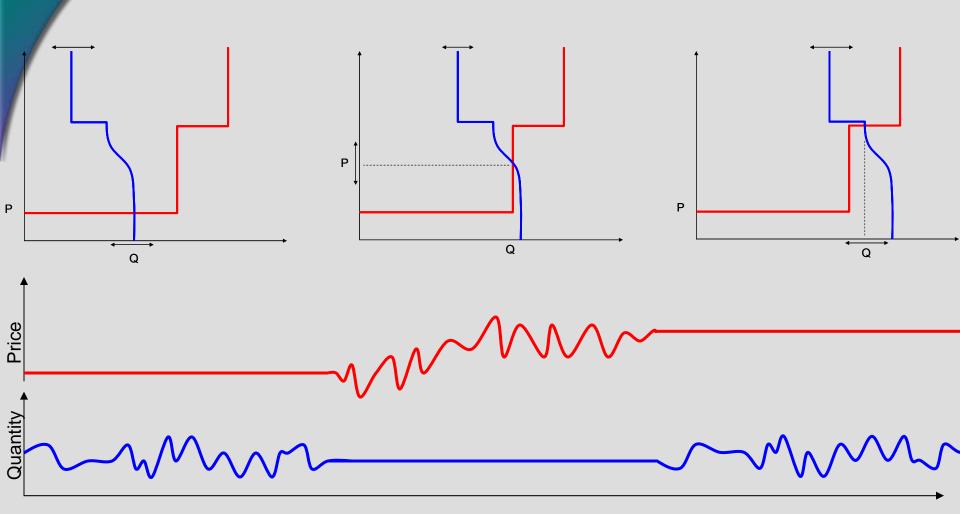
- Handled outside the normal utility energy bill; cost of energy from the market is paid for by Residential Customers with DoE-seeded funds in a managed account
- Both DR and DG assets bid into market
 - Base clearing price is calculated from the Mid-Columbia wholesale market price, adjusted based on real-time market demand and constraints

Price-based Distribution Dispatch



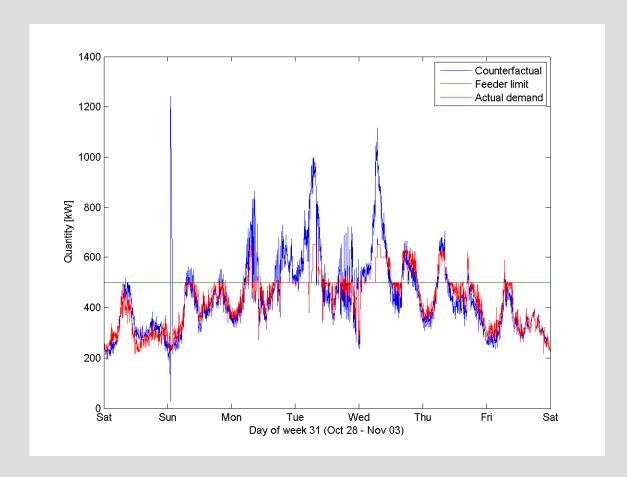


How real-time price flattens load



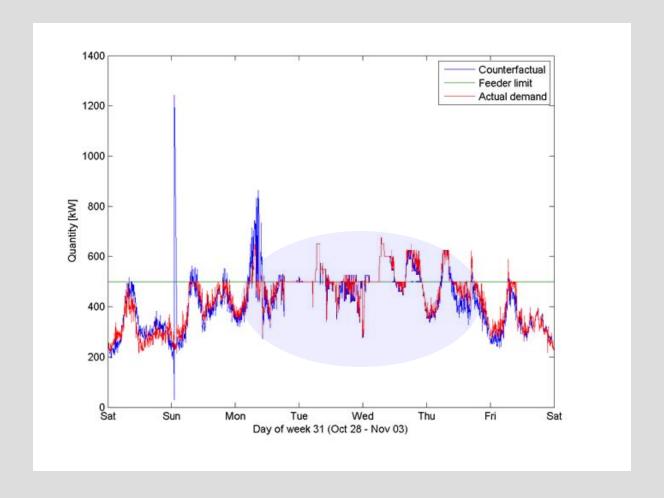
Time

Feeder capacity impact High load with good response





Feeder capacity management: Load flattening under high-load conditions



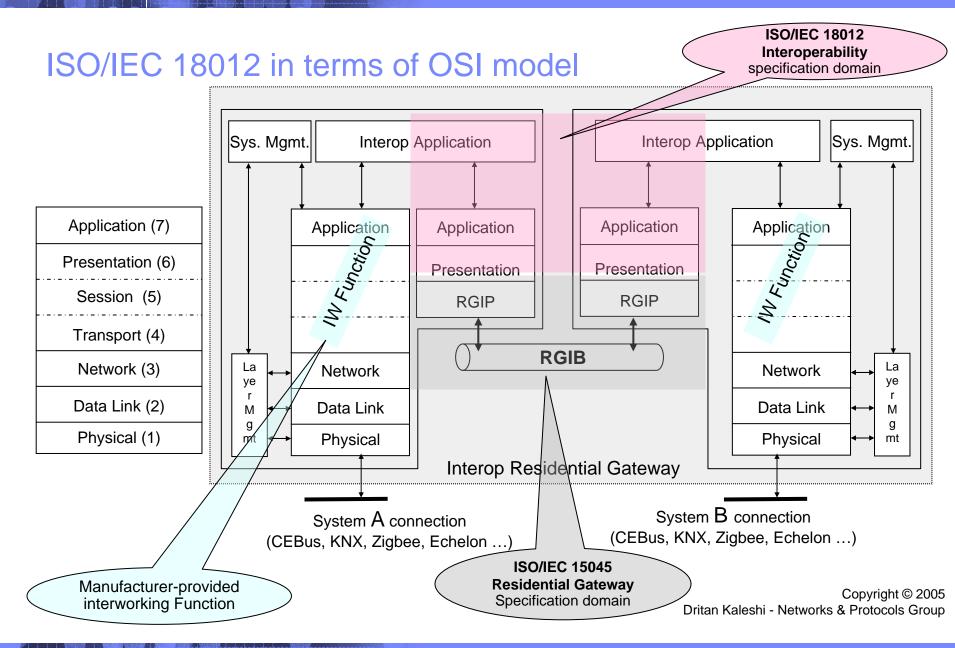




The Need for an Interoperability Framework The GWAC Stack as applied in Olympic Peninsula project

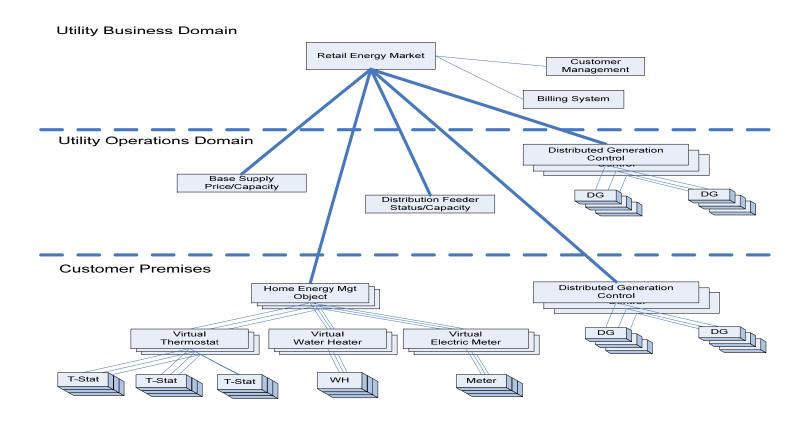
We defined assumptions about the real-time market model that we wished to test 8: Economic/Regulatory Policy Defer capital investment; improve response to Organizational unplanned outages 7: Business Objectives Real-time market and buy/sell bids as the primary optimization mechanism 6: Business Procedures Real-time Pricing accounts with customers 5: Business Context Informational Defined virtual devices that combined the physical device functions with addl business 4: Semantic Understanding process information flow & functions Used an implementation of ISO/IEC 18012-2 to establish heterogeneous interoperability and 3: Syntactic Interoperability enable semantic model above IP and non-IP bridged by a gateway – little or no application function in the gateway 2: Network Interoperability **Technical** Heterogeneous mix of wired and wireless technologies 1: Basic Connectivity







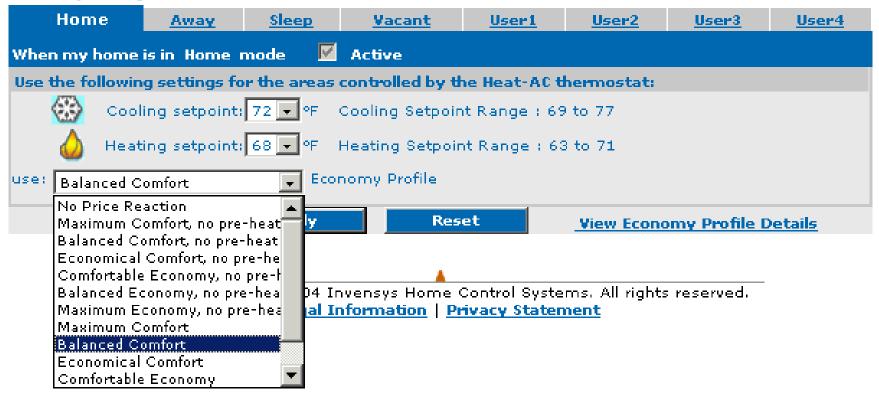
The Virtual Thermostat Object



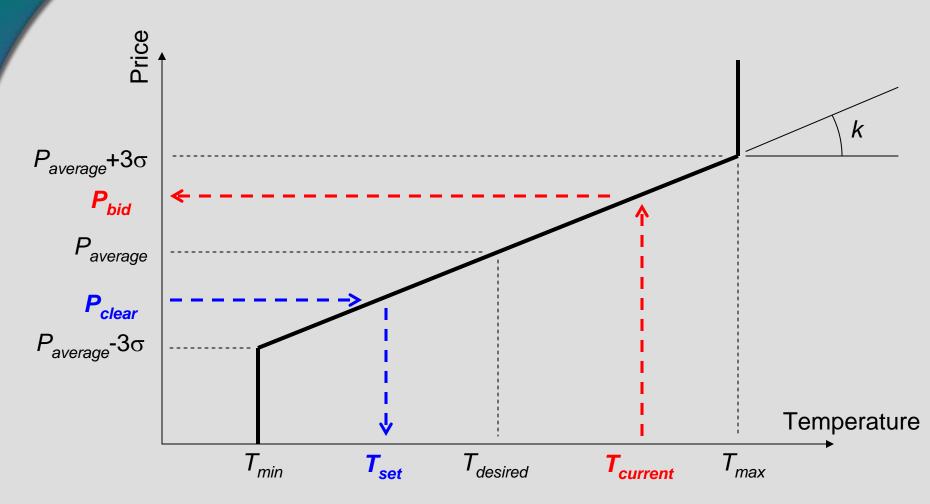


User Goal-based Preferences

Occupancy Modes



RTP Control for Thermostatic Devices



Small k: low comfort, high demand response

Large k: high comfort, low demand response







Results

- An Internet-based network coordinating DR can save consumers money on power, and reduce peak load on the grid by approximately 15% over the course of 1 year.
- A significant number of customers will sign up for and respond to a real-time price that varies on a 5-minute interval when they are provided computer-based technology that automates their response and preserves their right to choose their preference for comfort or savings.
- A combination of demand response and distributed generation reduced peak distribution loads by 50 percent for days.
- Utility-dispatched DR can alleviate the need to build expensive new infrastructure to address constraints on the T&D system during times of peak demand.
- Successfully managed a "virtual" distribution line, or feeder, and an imposed feeder constraint for an entire year
- The technologies and approach proved technically feasible, wide-scale adoption is more limited by regulations than technical limitations.

Pacific Northwest Smart Grid Regional Demo

- Expands upon the 2006 DOE-funded Pacific Northwest Gridwise Demo project
- Spans Idaho, Montana, Oregon, Washington, and Wyoming, 12 utilities, \$178M over 5 years
- Objectives:
 - Validate smart grid technologies and business models
 - Provide two-way communication between distributed generation, storage, and demand assets and the existing grid infrastructure
 - Quantify smart grid costs and benefits
 - Advance standards for interoperability and cybersecurity approaches
- Team will implement a unique distributed communication, control, and incentive system
- ▶ IBM Research team leading overall system architecture and interoperability/integration and contributing to cybersecurity, analytics (for DER), and secure messaging







Thank you

