Demand Response Enabling Technologies Development (DR ETD) Project

DR ETD TAC Meeting

February 21, 2007

Gaymond Yee & Ron Hofmann

CIEE

Agenda

- 10:00-10:15 AM: Gaymond Yee **(Welcome)**
- 10:15-10:30 AM: Ron Hofmann **(Introduction)**
- 10:30-10:45 AM: Nate Ota **(Disaggregated Thermostat)**
- 10:45-11:00 AM: Therese Peffer **(Adaptive Learning Controls)**
- 11:00-11:15 AM: Eli Leland **(MEMS Power Sensors)**
- 11:15-11:30 AM: Nate Pletcher **(Micro-Power Wireless)**
- 11:30-11:45 AM: Beth Reilly **(Micro-Power Generation)**
- 11:45 AM-12 PM: Dan Steingart **(Micro-Power Storage)**
- 12:00-12:15 PM: Paul Wright **(Micro-Integration)**
- 12:15-12:45 PM: **Lunch**
- 12:45-1:45 PM: **Lab tours (Micro-Fab & Dispenser Printing)**
- 1:45-2:00 PM: **Q&A**
- 2:00 PM: **Adjourn**

DR ETD Project

- CEC PIER Funded Project
  - Approved June 2002
  - Present funding: $9M to December 31, 2009
- Purpose - Fund research to develop **enabling technologies** for DR applications
  - Mid- (3-5 years) to long- (5-8 years) term objectives
  - **Not product development**
  - Potential for 10 x functionality and 1/10th the cost
  - **Disruptive technology**
  - Multi-disciplinary and collaborative research
  - Leverage R&D spending by other institutions

RESEARCH OPPORTUNITY NOTICES

- Research must address objectives in the five Research Opportunity Notices (RONs)
  - Meters
  - Thermostats
  - Network Management
  - System Integration
  - Control and Communications Integration
- Technical Advisory Committee (TAC) members from IOUs, private industry & national R&D labs review proposals, make funding recommendations

Completed Projects (1 of 2)

- DR Business Network (DR BizNet)
  - Utility Integration Solutions (UISOL), Nexant, & others – Phase 1 completed April 2005 – Phase 2 completed September 2006
  - Designed and developed an architecture and framework to integrate, automate, and optimize utility internal DR systems and processes
  - Field simulation demonstration with CAISO, IOU's, & aggregator on August 11, 2006
  - To be commercialized by Sempra, parent company of SDG&E – **could reduce demand response program enrollment times from months to hours**

Completed Projects (2 of 2)

- Network Security Architecture
  - Cyberknowledge & UCB (EECS & Law School) – completed September 2005
  - Investigated security and **privacy** issues related to data and information from sensor networks deployed for DR
- Universal Application Interface
  - BWRC, Technical University of Berlin & UCB – completed December 2006
  - Draft final report under review
  - Developed and demonstrated an universal application interface for **ad-hoc wireless sensor and actuator networks**

Current Projects

- Barrier-Immune Radio Communications (BIRC)
  - LBNL & LLNL – to be completed by June 30, 2007
  - Investigate the use of ultra-wide-band (UWB) and/or other technologies for radio **communications between floors in commercial buildings**
- UC Berkeley Micro-electronic building blocks for smart meters and communicating thermostats
  - On-going since March 2003
  - ME, EECS, BSAC, CBE & BWRC
  - **UCB's R&D activities will be the focus of today's presentations, tour and discussions**

Imagine

A statewide signaling infrastructure that can let your appliances, HVAC units, lighting, pool pumps, and other electrical equipment know when electricity prices are high (or low) and/or when the grid is having a problem so that non-critical devices can enter factory-programmed, low-power modes to help avoid forced outages

Imagine

An information-rich environment in your home (e.g., from a Disaggregated Thermostat) that automatically balances your energy and peak usage with personal lifestyle requirements (using Adaptive Learning Controls) to minimize carbon production & cost while maximizing comfort, convenience & productivity

Imagine

Your energy and power costs available at any time on any display in your house (thermostat, TV monitor, PC monitor, refrigerator LCD) or on your person (cell phone) so you can control your energy usage before your bill comes at the end of the month

Imagine

Distributed self-powered sensors (e.g., MEMS Power Sensors) that are so small that they can be embedded with communications capability (e.g., Micro-Power Wireless) in any device, even a power cord, so local energy and power use can be measured

Imagine

Environmental sensors (temperature, humidity, occupancy) with communications that can be placed anywhere (require no special installation) and can be powered by ambient vibrations (MEMS Power Generation) that is stored using advanced batteries and capacitors (Micro-Power Storage) that lasts for over 10 years

UC Berkeley ETD Project

- The enabling technologies being developed at UC Berkeley are focused on Demand Response (DR) applications related to the deployment of smart meters and disaggregated thermostats.
- However, what you are going to see today may be applied to energy efficiency (EE), distribution automation (DA) and other electricity-related areas
- We encourage you to think outside the box when you consider how these technologies might be used to save energy and reduce greenhouse gases (GHG)

UC Berkeley Historical R&D

- Smart Dust (Wireless Sensor Networks)
- TinyOS (Mesh network operating systems)
- Fuzzy logic (Adaptive control algorithms)
- MEMS (Low-cost silicon sensors & vibration energy scavengers)
- Pico-radios (Low-cost, low-power silicon radios)

- …….

UCB DR Enabling Technologies

- Disaggregated Thermostat
  - Mesh networks
- Adaptive Learning Controls
- MEMS Power Sensors
  - Voltage & current
- Micro-Power Wireless
- Micro-Power Generation
- Micro-Power Storage
  - Batteries & capacitors
- Micro-Integration