Open Automated Demand Response Communications in Demand Response for Wholesale Ancillary Services

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Presentation Overview

– Objectives
– System Architecture
– Methodology
– Results
– Conclusion and Next Steps
Participating Load Pilot Project

• Research Objectives:
  – Can OpenADR be used for ancillary services?
  – Are current DR strategies in C&I fast enough for fast DR?
  – Can the communication infrastructure over the Internet accommodate fast DR requirements: PL Resources have to meet non-spinning reserve requirements:
    • the resources have to deliver energy within 10-minutes,
    • be available for 2 hours, and
    • provide real-time telemetry to the CAISO

• PLP Team:
  – PG&E
  – Itron
  – Akuacom
  – CAISO
  – Metrum Technologies
  – Bow Networks
  – LBNL
Participating Load Pilot (PLP) Architecture

Acronyms:

EMS – Energy Management System
ADS – Automatic Dispatch System
SIBR – Scheduling Infrastructure Business Rules
DRAS – DR Automation Server
CLIR – Client Logic with Integrated Relay
RM – Revenue Meter
T – Telemetry

Methodology

- **Site Selection**: Developing criteria that considers load variability, weather sensitivity and load statistical summaries

- **DR Strategies**: Each facility used their existing DR strategies. One facility tested the use of feedback.

- **Ramp Rate Calculations**: (MW/min)

- **Data collection**: 15 min, 5 min and 4 sec. data

- **Demand Shed Calculations**: Forecasted loads are considered baseline.

- **Settlement Calculations**: (Actual Meter – DayAhead Schedule) X Real-Time Price

- **Dispatch Signal Propagation**: Dispatch received in XML
## DR Strategies

<table>
<thead>
<tr>
<th>Site</th>
<th>DR Strategy</th>
<th>DR Period</th>
</tr>
</thead>
<tbody>
<tr>
<td>IKEA EPA</td>
<td>Turning off 11 RTUs out of 43 and raising zone setpoints to 76 DegF</td>
<td>Noon to 6 pm</td>
</tr>
<tr>
<td>Contra Costa</td>
<td>4 DegF Global Temperature Adjustment with 1 DegF increments</td>
<td>2 pm to 6 pm</td>
</tr>
<tr>
<td>County</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Svenhards</td>
<td>Turn off Pan Washer</td>
<td>3 pm to 5 pm</td>
</tr>
</tbody>
</table>
OpenADR Signals – Critical Peak Pricing (CPP)
OpenADR signals - PLP

<table>
<thead>
<tr>
<th>PLP Event</th>
<th>Start Time</th>
<th>End Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ramp Period</td>
<td>ACTIVE</td>
<td>IDLE</td>
</tr>
<tr>
<td>Price</td>
<td>Nor.</td>
<td>Mod.</td>
</tr>
<tr>
<td>Load Level</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>
# Test Dates and Sample Results

<table>
<thead>
<tr>
<th>Site/Date</th>
<th>17-Jul</th>
<th>6-Aug</th>
<th>27-Aug</th>
<th>31-Aug</th>
<th>11-Sep</th>
<th>18-Sep</th>
<th>21-Sep</th>
<th>22-Sep</th>
</tr>
</thead>
<tbody>
<tr>
<td>IKEA EPA</td>
<td>15:00 - 17:00</td>
<td></td>
<td></td>
<td>14:40 - 14:43</td>
<td>16:00 - 16:25, 16:35 - 16:50</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CCC</td>
<td>15:00 - 17:00</td>
<td>17:00 - 18:00</td>
<td>14:00 - 15:00</td>
<td>14:40 - 14:43</td>
<td>16:00 - 16:25, 16:35 - 16:50</td>
<td>14:00 - 16:30, 16:40 - 17:55</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Svenhards</td>
<td>15:00 - 17:00</td>
<td>15:00 - 16:00</td>
<td>15:25 - 15:30</td>
<td></td>
<td></td>
<td>16:00 - 16:25, 16:35 - 16:50</td>
<td>16:30 - 16:40</td>
<td>16:55 - 17:00</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Site</th>
<th>Date</th>
<th>vs. Actual Ramp Rate (MW/min)</th>
<th>Forecasted vs. Actual Average Load Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>HE 15:00</td>
</tr>
<tr>
<td>Office</td>
<td>21-Sep</td>
<td>0.002/0.006</td>
<td>20/72</td>
</tr>
<tr>
<td>Bakery</td>
<td>18-Sep</td>
<td>0.012/0.012</td>
<td>-</td>
</tr>
<tr>
<td>Retail</td>
<td>18-Sep</td>
<td>0.001/0.01</td>
<td>-</td>
</tr>
</tbody>
</table>
Contra Costa County – Office Building

PLP EVENT

- Actual 5 min. Data
- Hourly Forecast with reduction
- Forecasted Data

Time of Day

Demand (kW)
Conclusion

• HVAC as an end use and global temperature adjustment as a DR strategy meet the requirements for wholesale ancillary services.

• OpenADR specification is used to communicate wholesale DR events in an open and interoperable way.
  – Customer’s transition from Auto-DR programs to PLP is seamless

• Internet can be used for fast DR to dispatch non-spinning ancillary services.
Next Steps

• Need to resolve glitches....
  – Dispatch rules were assumed to be sorted at the CAISO system and little intelligence was programmed into the DRAS in terms of program rules. DRAS can be used as a second check point for dispatch rules.
  – Maximum duration of dispatch and number of events for the PLP sites is not sufficient to test sustainability of sheds.

• Forecasting loads is a complex process and highly variable loads are extremely difficult to forecast. There is a need to develop better forecasting methods where load characteristics and changing in loads are better incorporated in the forecasting algorithms.

• Cost of telemetry for each site needs to be analyzed and scalability issues need to be explored.

• Settlements were not completed by the time this paper was written. Various value streams should be investigated.
Thank you!

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Automation Goals and Definition

-Recent Research Goals
  • **Cost** - Develop low-cost, automation infrastructure to improve DR capability in California
  • **Technology** - Evaluate “readiness” of commercial buildings to receive signals
  • **Capability** - Evaluate capability of control strategies for current and future buildings

-Auto-DR Definition - Fully automated signals for end-use control
  • **Signaling** — Continuous, secure, reliable, 2-way comms; listen and acknowledge
  • **Industry Standards** - Open, interoperable communications to integrate with both common EMCS and other end-use devices that can receive a relay or similar signals (such XML)
  • **Timing of Notification** - Day ahead and day of signals facilitate diverse strategies
Auto-DR Multi-Year Technology Development Summary

- Develop Demand Response Automation Server (annually updated)
- Develop connection to Energy Management Control Systems (EMCS)
- Field Tests – Recruit sites/ 2 to 12 events per summer
  - 2003 - 5 sites – Internet link to Energy Information Systems (EIS)
  - 2004 - 18 sites - linked to EIS and EMCS
  - 2005 - PG&E CPP collaboration
  - 2006 - PG&E, SDG&E, Planning with SCE
  - 2007 - PG&E and SCE
  - 2008 - PG&E and SCE
  - 2009 - Bonneville Power Administration/ Seattle City Light, Participating Load Pilot w/ PG&E
- Evaluate with weather normalized baseline
- Interview site after each event

<table>
<thead>
<tr>
<th>Year</th>
<th># of Sites</th>
<th>DRAS</th>
<th>Site Communications</th>
<th>Utility</th>
</tr>
</thead>
<tbody>
<tr>
<td>2003</td>
<td>5</td>
<td>Infotility</td>
<td>XML Gateway Software</td>
<td>None</td>
</tr>
<tr>
<td>2004</td>
<td>18</td>
<td>Infotility</td>
<td>XML - Internet Relay</td>
<td>None</td>
</tr>
<tr>
<td>2005</td>
<td>11</td>
<td>Akuacom</td>
<td>XML - Internet Relay</td>
<td>PG&amp;E</td>
</tr>
<tr>
<td>2006</td>
<td>25</td>
<td>Akuacom</td>
<td>XML - CLIR</td>
<td>PG&amp;E, SDG&amp;E</td>
</tr>
<tr>
<td>2007-08</td>
<td>200+</td>
<td>Akuacom</td>
<td>XML - CLIR</td>
<td>Statewide</td>
</tr>
</tbody>
</table>
Schedule Submission Process

Two days before trading day

Load bid and Pseudo Generating bid forecasted by 3 pm and placed in a secure folder

PG&E provides ITRON with historical and forecasted weather and historical load data

ITRON Metrix IDR™ generates 5-min, 7 day rolling load and pseudo generating bids

Any changes in operations is communicated to PG&E by the facility operators

One day before trading day

Hourly Bids to PG&E procurement by 5 am.

CAISO Day Ahead Market closes at 10 am and DR awards are published by 1pm

Last minute exceptions to customer loads communicated to PG&E by 9 am

Trading day

Awards may be dispatched by the CAISO
IKEA Hourly Loads and Actual 5 Minute Load Data

Time of Day

Demand (kW)


Forecasted-Actual Hourly Bid

-200 -100 0 100 200 300 400

Time of Day