

# Residential Energy Gateway (REG) Reference Design

## **Overview**

Since 2009 we have been developing a software suite to enable different HAN components to exchange energy-related information and participate in supervisory control events. The software uses the highly modular OSGi software framework for JAVA to enable interoperability between heterogeneous communications media in the residence. The software easily allows new applications to be integrated into the existing codebase.



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#### **Milestones/Achievements**

- Embedded web server
- Embedded database
- DHTMLX scheduler
- Integrated external demand response resource into REG (OpenADR)
- Smart Meter connection
- 5 conference publications
- 2011 DOW Sustainability Innovation Student Challenge Winner
- Project completion: December 2013



## As a tool for control:

Operate plug loads for demand response

$$\min_{[x_1, x_2, \dots, x_n]} \left| \gamma_k - \sum_{i=1}^n c_{i,k} x_i \right| + \beta_k \left( \sum_{i=1}^n \gamma_i x_i \right)$$

# s.t. $\sum_{i=1}^{n} p_{i,k} x_i \leq \sigma_k$ , $x_i \in \{0,1\}$

x <sub>i</sub>	Actuation state of device (outlet): 0 = on, 1 = off	Solved for
γ <sub>t</sub>	Load shed goal at time <i>t</i> [W] (shed from prior to event)	From CBC
C <sub>i,t</sub>	Power use of device <i>i</i> at time <i>t</i> [W]	Device property
p <sub>i,t</sub>	Incurred inconvenience from actuation of device <i>i</i> at time <i>t</i>	User defined
$\beta_t$	Weighting between meeting shed goal and inconvenience [W]	From CBC
$\sigma_t$	Maximum allowable inconvenience for time t	From CBC

CBC: Central Building Controller – sends control signals to Gateways in DR testing

#### **Resulting Load Shed**



#### **Resident Inconvenience**



Controller



