

LoCal – A Network Architecture for Localized Electrical Energy Reduction,
Generation and Sharing
CPS Medium Project 0932209
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LoCal seeks to develop a foundation for a cooperative grid in which loads and supplies interact through an Information Plane overlaying the Electrical Plane to substantially increase the potential penetration of renewable sources, despite their variable and intermittent production. It follows a multi-scale empirical research plan of supply-following data centers within buildings within a virtual private grid.

Recently, we have focused on connecting datacenter computation scheduling, and therefore energy consumption using techniques that we developed earlier for realizing power proportional clusters. We have demonstrated the ability to schedule work in concert with feeds from the California Independent Service Operator (CAISO) combined with real time wind traces. We have expanded our techniques for power proportional execution to include large-scale parallel computations using the high performance computing (HPC) Torque job scheduling facility. We have investigated a variety of techniques for improving the power proportionality of information storage devices, in addition to processors and networks.

We have expanded our work on building monitoring and the use of building facilities in the creation of supply-following-loads. Our techniques for power proportionality in core HVAC facilities have now been demonstrated in collaboration with campus facilities through the installation of a small (50 ton) pony chiller complementing the prevailing 200 ton chiller to service two buildings. Previously each building had its own chiller. Both buildings run 80% of the time off the small chiller and 20% off the large, whereas previously both chillers were running full time.

We have greatly expanded the array of physical resources available through our open SMAP (Simple monitoring and actuation protocol) demonstration capability. Through cooperation with campus facilities, we have direct real-time access to numerous meters that were previously only accessible through day-behind file exports from proprietary vendor products. We have also demonstrated automated proxying of full legacy BACNet through SMAP and are delivering several hundred additional sense points throughout the newly commissioned Sutardja Dai building into our analysis facility. This work demonstrates integration with the Siemens state-of-the-art Apogee Insight building management system.

Extending our Cory Hall monitoring testbed, in collaboration with the NSF Action Webs project, we have demonstrated comfort enhancing and energy saving environmental conditioning of a dedicated computer laboratory facility using learning-based model predictive control. The underlying model formation isolates the occupancy-driven heat load from the rest of the heat transfer process.

Finally, we are developing our energy analysis framework to facilitate the use of this widespread building energy usage data in summer undergraduate research programs, focused particularly on expanding the participation of women and underrepresented minorities in science and engineering.