Motivation

- Buildings are not currently analyzed as a complete system.
- Dense sensing is needed to understand, model and optimize the building as a proper cyber-physical system.
- Monitoring of human activity is essential to understanding the 'demand' of operations.
- Potentially tremendous improvements in energy savings, efficiency and occupant comfort await.

2012 Main Objectives

- Design a modular and high-reliability server to accept and process sensor data.
- Using power monitoring as a motivating example, demonstrate autonomous processing of the incoming data into a digestible form.
- Demonstrate novel visualization methods giving building managers the tools they need to check on the building.

The Problem

- Integration is fundamental to the project:
  - Physical world ↔ Digital world
  - Sensor hardware ↔ High-performance computers
  - Real-time reliable software ↔ Cutting-edge theory
- Scientific advancement and quality engineering are both essential to success of the project.

Sensing: Power measurement results

- Automatically measure charging curves of devices using instrumented power strip and mechanical timers.

Sensing: Device-level Power

- Find electrical energy that is being used unnecessarily.
- Device usage is a proxy for occupancy.

Analysis: Real-time Device Disaggregation Design

- Measure individual device parameters from learning nodes and store in database.
- Compute state and power use estimates from aggregate feeds.
- Developed preliminary implementation of key technologies: Sensing, Communication, and Analysis in the context of device power monitoring.
- Modular server architecture allows “plugging in” of algorithms as they become available.
- Ready to accept other types of time-series data, e.g. Temperature, Occupancy, light-level, etc..
- Efficient implementation runs at 79000 times real-time for a single stream.

Summary

- Accept non-time-series and structured data, such as keycard reader logs.
- Develop modular architecture for organizing and controlling of building actuators.
- Integrate system with other researchers’ architectures and unify metadata strategy.