An Extensible Sensing and Control Platform for Building Energy Management

DOE Award DE-EE0006353

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Sensor Andrew

- Infrastructure to help connect the *virtual* and *physical world*
- Access, store, control, describe and search sensor data while maintaining security and privacy
- Internet-scale performance and Extensibility

What makes this different from existing solutions?
Some Differences

• Open source, community driven and hacker-oriented (SDK)
• Reuses existing solutions for:
  – Access control / Privacy
  – Internet-scalability
• Separates measurements from meta-data.
• Minimalistic meta-data schemas
Sensor Andrew Highlights

• **Networking**
  – Publish-Subscribe Architecture
  – Device-Level Access Control

• **Storage**
  – Multi-Resolution Time Series Database
  – Cloud-to-Edge Hand-off
    • High-resolution data stored at routers
    • Aggregates intelligently pushed to server side

• **Device Interfaces**
  – FireFly Wireless Sensing Platform, BACnet, Android@Home, NEST thermostat, Web Services, ModBus, PUP, Zigbee, Zwave
Respawn Distributed Datastore
Respawn Approach

- Key techniques:
  - multi-resolution tiling / lossless compression
  - cloud-to-edge partitioning
Request Handling

- Dispatcher redirects client requests to edge/cloud.
- REQUEST: (device, channel, level, offset)
  - “HTTP/1.1 GET /tile/sensor.temperature/10.2609.json”
- RESPONSE: JSON object
Sensor Andrew Applied to Building Automation Systems (BAS)

- BAS Composer
- BAS Executive
- BAS Viewer

Sensors Over XMPP (SOX)

- BAS Adapter
- BAS Adapter
- BAS Adapter

FF Plug  FF Environmental
CMEL

Pneumatic  Matrix
HVAC

Hue  InScope
Lighting
Scaife Hall Deployment

40,000 sq ft, 5 story, 140 room, 8 hallway, academic building built in 1962 with classrooms, auditorium, offices and labs.
Instrumentation Roadmap

**EnFuse Panel Meters**
Electricity usage
11 x 48 = 528 feeds

**AutoMatrix PUP Controller**
HVAC
30 x 6 (inter-building) x 24 = 4320 feeds

**Thermostat**
802.15.4 Pneumatic thermostat with branch pressure monitoring
70 feeds

**Fan Control Units**
802.15.4 units for heat exchangers in each room
Control and power metering
170 feeds

**OSRAM Lighting Controller**
277 VAC lighting control
15 x 2 = 30 feeds

**FireFly Environmental**
Light, temp, humidity, sound, motion, vibration, pressure
120 feeds

**Chilled Water and Steam**
Temperature and flow-rate
2 x 2 = 4 feeds

**Localization**
ALPs + VLC Localization
Feed per person
Conclusions

• Existing Buildings
  – Rapid / low-cost deployment

• Leverage Open Standards
  – XMPP, IFC, BIM Surfer

• Scalable Backend
  – Storage, Communication, Analytics