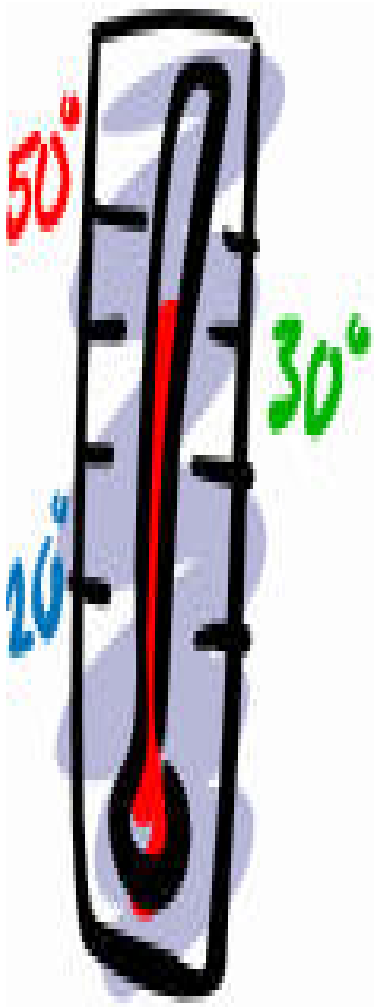


Research Opportunity Notice

Temperature measurement

Classic Electromechanical Thermostat

- **Inexpensive, <$30, installed**
- **Fixed setpoints**
- **Bimetal sensing elements**
- **Mercury or mechanical contact actuators**
- **No Communications capability**

Electronic Thermostat

- More expensive, $50-$100, installed
- User display
- Multiple programmable setpoints
- Solid state sensing elements
- Electronic or mechanical actuators (relay)
- Battery powered, line powered, steals power
- No remote programming capability

Communications in Thermostats

State of the Art

- **Dependent on system design, no standard communications technique or protocol**
- **Integral to thermostat design, not an add-in**
- **Variety of methods used**
  - Hardwired (RS-232, RS-422, RS-485)
  - IR
  - Powerline carrier (x-10, Echelon, CEBus)
  - RF, one-way, two-way

Objective of Demand Response Project

- **Develop <u>enabling technology</u> for an integrated communicating temperature sensing node that can support dynamic tariffs and demand response**
  - Integrated sensors
  - Universal communications solution
  - Low cost, universal product

Possible Devices

- **Integrated primary residential thermostat**
  - **NewStat**
- **Measurement node for use in groups within a space to be controlled**
  - **TempNode**

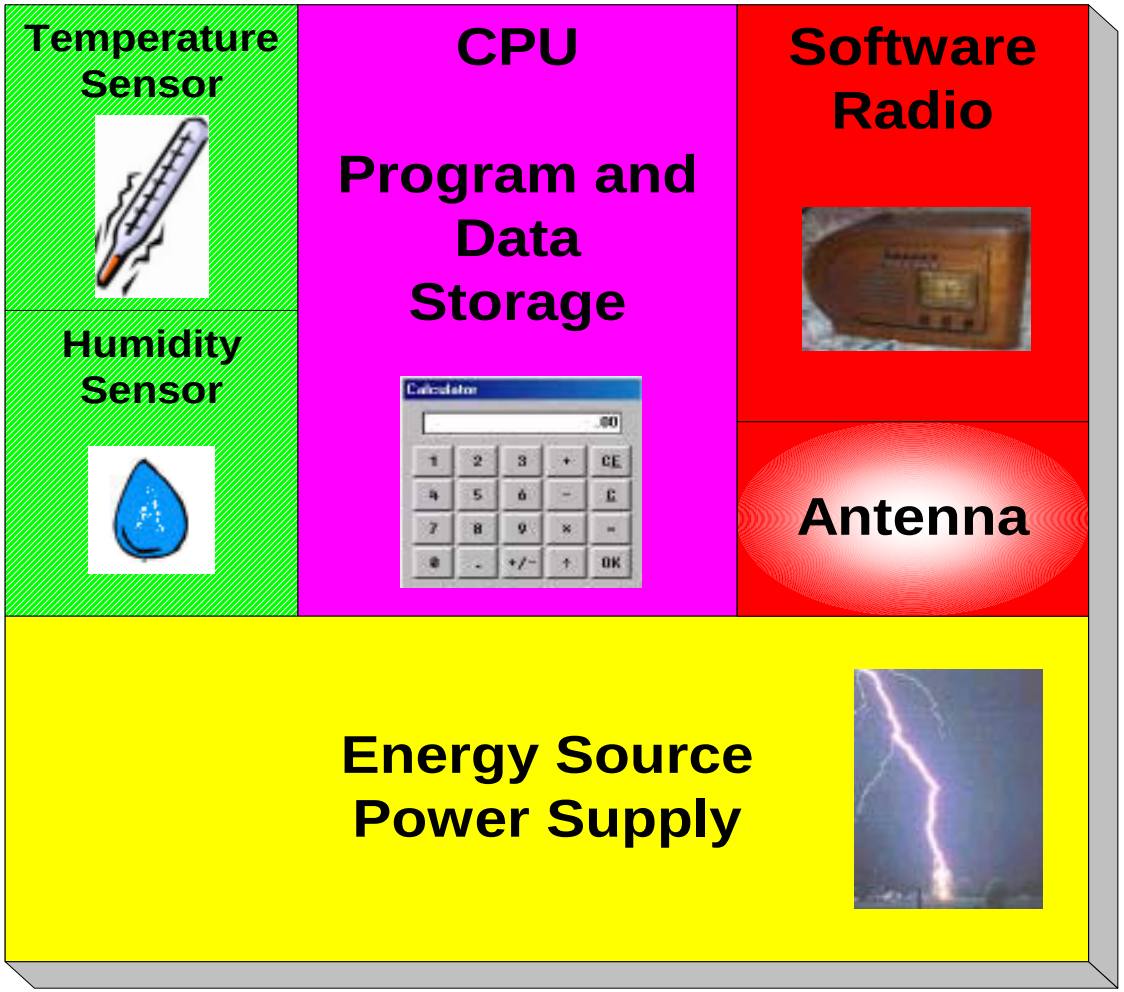
Goals of the NewStat

- Installed cost <$30
- Communications range 10-300M, efficient wireless network
- Easy installation
- Scavenge Energy for operation
- Support for dynamic tariffs and DR
- Increased functionality, humidity, comfort, etc.
- Clear and intuitive user interface

Goals of the TempNode

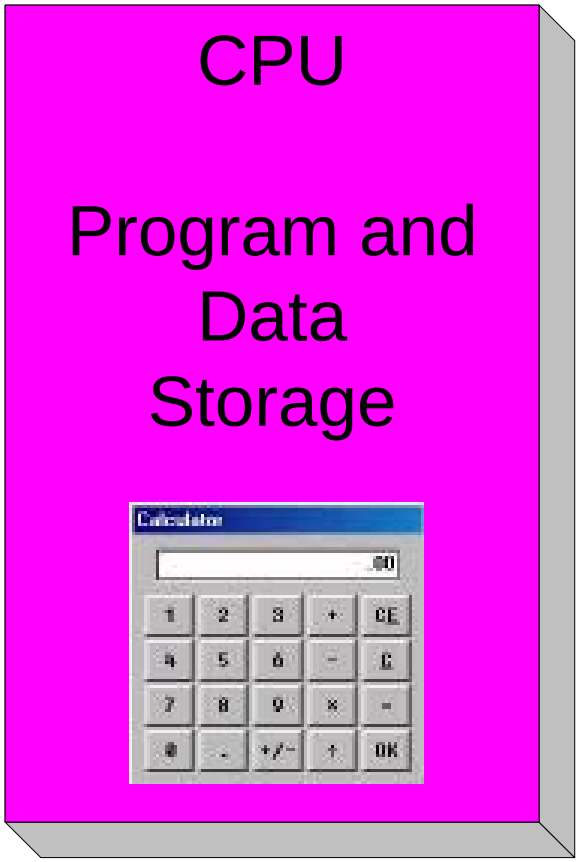
- Installed cost <$10
- Communications range 10-50M, efficient wireless network
- Easy installation in self-organizing networks
- Scavenge Energy for operation
- Support for dynamic tariffs and DR
- Measure additional environmental parameters

Example NewStat Implementation



NewStat

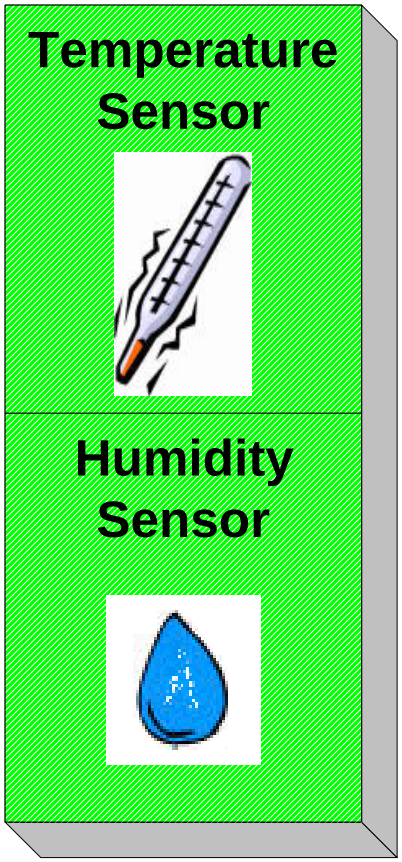
(Platform)



- **Hardware/Firmware reconfigurable remotely and fail-safe**
- **Allows new features and tariffs to be added remotely**
- **Computes “comfort” and adjusts setpoints accordingly**
- **Computes and implements reactions to real-time price signals**
- **Monitors health of air handlers**

NewStat

(Sensors)



- **Integral to chip for low cost, “smart” calibration**
- **Measures temperature and humidity**

NewStat

(Power Supply)

Energy Source
Power Supply

- **Energy scavenged from environment or load**
- **Sources include vibration, illumination, heat, or the circuits being controlled.**

NewStat
(Communications)

- **Remotely configurable for new capabilities**
- **Integral “smart” antenna**
- **WAN to the outside world**
- **LAN to TempNodes and NewMeter**

NewStat

(User Interface)

- **Clear and intuitive UI**
  - May be radically different than existing text/button interfaces
  - Allows user input to price signal actions
  - Displays status of all parameters and decisions
  - Avoids “flashing VCR clock syndrome”

NewStat

(Additional Specifications)

- **Installed cost <$30**
- **Packaging supports easy installation and use**
- **Installation requires no new wires**

Example TempNode Implementation

NewStat capabilities, without

- User Interface
- Actuators
- WAN support

TempNode

(Specifications)

- **Technical requirements similar to NewStat**
- **Capable of measuring other parameters, IAQ, illumination, smoke, etc.**
- **Self-organizing LAN network**
- **Cooperative behavior among units**
- **Detect trends, patterns, anomalies and report**
- **Installed cost <$10**

Summary

The purpose of this RON is to solicit proposals for R&D tasks that will develop enabling technologies for the NewStat and TempNode, NOT to produce a product.

Areas of likely interest are:

- Temperature and Humidity sensors
- On-chip integration
- Algorithms for comfort and real-time pricing
- Energy scavenging
- Self-organizing networks
- OS and UI
- Packaging
- Others not mentioned here