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PHIUS 2021 MECHANICAL SUMMIT

APRIL 19 - 22

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CONTROLS-THREAT OR MENACE?

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CONTROLS – THREAT OR MENACE?



Earn X CPHC CEUs

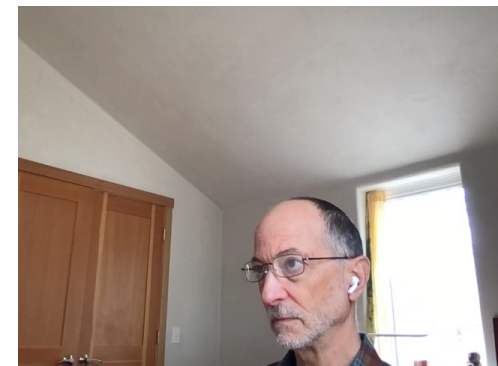
Self-report at:

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Controls – Challenges and Opportunities

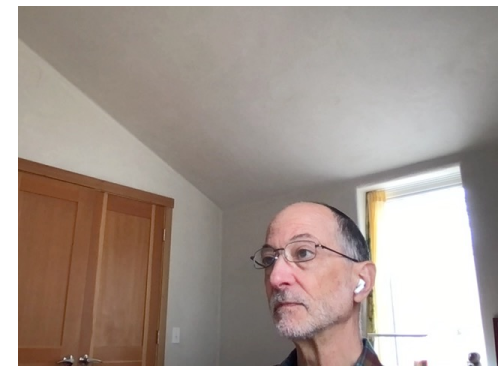
- What we would like from system controls:
- Incorporate accurate and robust sensors
- Maintain desired setpoint (T, RH, CO₂) with appropriate steps
- Integrate multiple systems (even fuels) seamlessly
- Respond to variable occupancy, contaminant level, outdoor conditions, loads
- Be highly customizable/programmable without *requiring* programming (sensible defaults) while presenting an easily understood user interface
- Incorporate operational data logger

Some of these cannot be separated from changes in the systems themselves



Sensors and setpoint

- What level of accuracy is needed?
 - Temperature – 1 °F (0.6 °C)
 - RH – 5% or Dewpoint F (C)
 - CO₂ – 50 ppm
- What level of precision is needed?
- What is acceptable sensor drift over time? Can the sensor self-calibrate?
- Where is the best location to sense the process/condition the system is responding to?
- Which sensor to use when?
- How difficult is it to re-locate the sensor?



Integration with Other Systems

- Fossil fuel or electric heat with heat pumps
 - One control integrates heat pump and supplementary system, user intervention not required
 - Adjustable differential and/or logic for bringing second stage on
 - Outdoor sensor to prevent unnecessary operation
- Heat pump air handlers with ventilation – air handler runs continuously on user-settable low speed to circulate fresh air when no call for H/C
- Heat pump air handlers with dehumidification – air handler runs continuously on user-settable low speed to circulate dry air when there is a call for dehumidification and no call for l



HVAC System Integration

SYSTEM OPERATION



	Heating/Cooling Heat Pump Zones	Heating Radiant Bathroom Zones	Heating / Cooling M-Bedroom Sub-Zone
Occupied Heating Season			
System Setting	HEAT	HEAT	HEAT
Fan Setting	AUTO	N/A	N/A
Setpoint	68F	70F Schedule 6AM-9PM	60F
Unoccupied Heating Season			
System Setting	HEAT	OFF	HEAT
Fan Setting	AUTO	N/A	N/A
Setpoint	55F	N/A	60F
Window Closed Cooling Season			
System Setting	COOL	OFF	COOL
Fan Setting	AUTO	N/A	AUTO
Setpoint	76F	N/A	60F
Window Open Cooling or Shoulder Season			
System Setting	OFF	OFF	OFF
Fan Setting	N/A	N/A	N/A
Setpoint	N/A	N/A	N/A



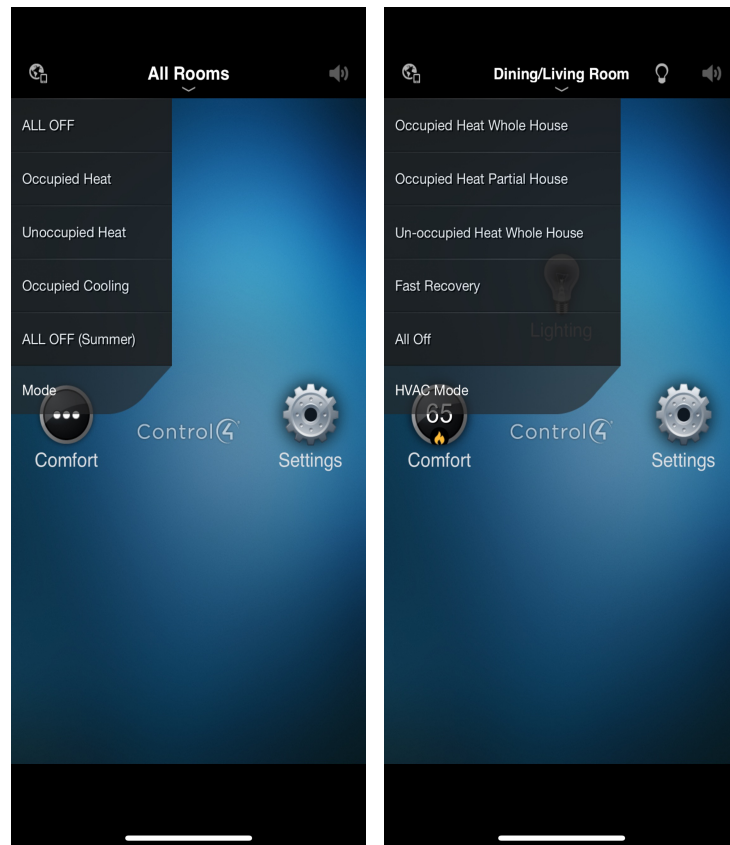
Control Communication Protocol, Signal

- Commercial Control Protocol and standards
 - Modbus RTU & TCP/IP
 - BacNet MSTP & TCP/IP
 - CANbus
 - Ethernet TCP/IP
 - Proprietary protocol (VRF, Minisplit)
- Home Automation Control Protocol and standards
 - ZIGbee
 - Z-wave
 - Wifi
 - API
- Common Control Signal
 - 0-10VDC, 0-20 or 4-20mA, Thermistor

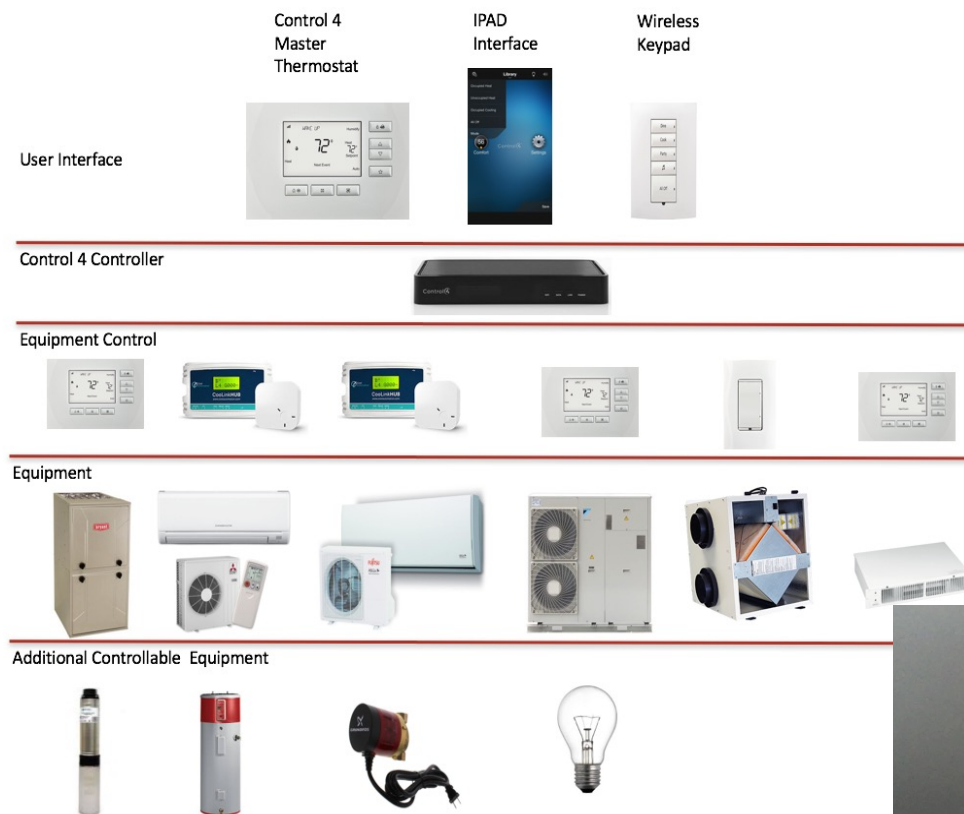


Home Automation HVAC System Integration

School/House Control Interface

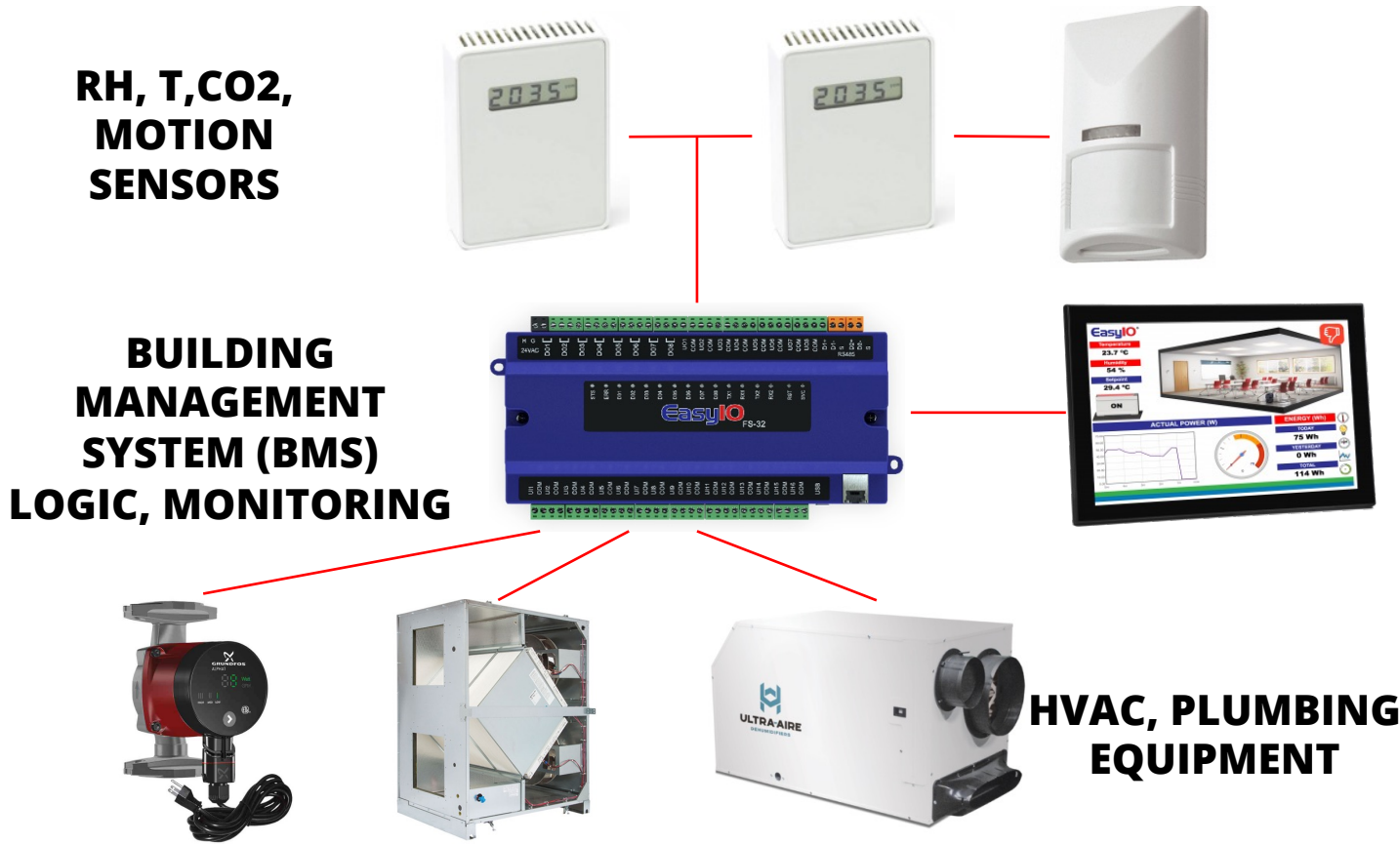


System Schematic



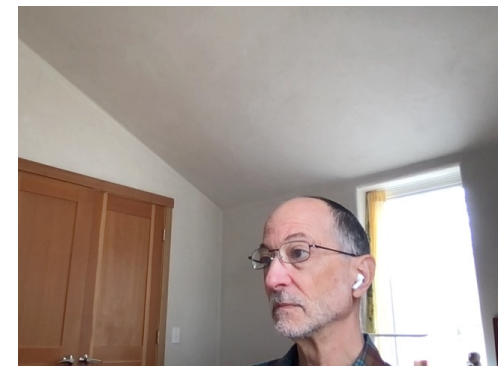
Commercial HVAC System Integration

System Schematic



Ventilation Controls

- Controls that operate frost protection only when there is an actual frost potential condition
- Controls that operate electric make up air heater to provide full modulation and accurate discharge setpoint temperature
- Controls allowing ventilation system to modulate between the minimum and maximum fan operating point
- Controls that sense air quality and boost flow when necessary and minimize flow when building is unoccupied (a la CERV)
- Controls and reliable powered dampers (is this an oxymoron?) that boost exhaust only from the location (bathroom, usually) requiring it
- Integrated make up air control and heater that follows exhaust fans

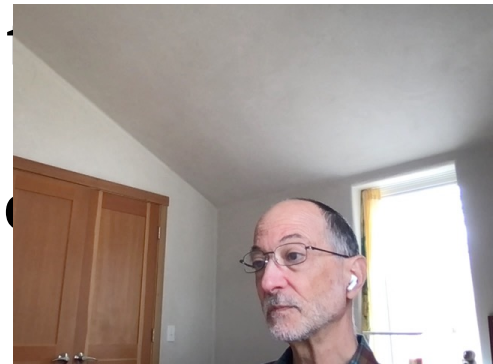


Systems We'd Like to Have

- Energy recovery ventilator incorporating BOTH a high efficiency enthalpic core and a heat pump, so the unit maintains space conditioning capacity at design conditions
- Air-to-water heat pump capable of 160 °F water at 0 °F outdoor conditions
- Common Wireless Control Signal Protocol

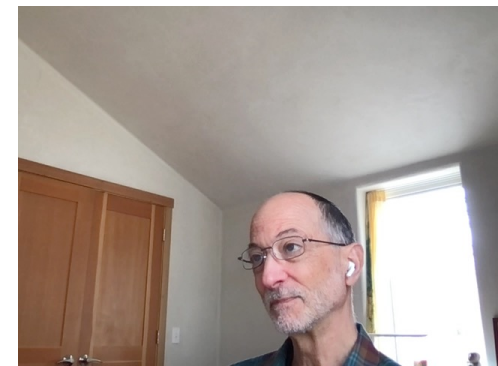
In the 'I can dream, can't I' department:

- A refrigerator/freezer that preheats domestic hot water
- A PV inverter/EV charger that incorporates a transfer switch and allows using the traction battery for emergency power to the house
- A truly sealed combustion wood stove that is backdraft-proof



What we have learned

- Don't overpromise before implementing a new system
- Because a manufacturer sells it, it doesn't mean that it works
- Hire a commissioning agent or include commissioning scope for your HVAC/Plumber installer
- Install data-loggers and analyze data the first year of operation
- Don't rely on broadcasted internet signal to control your HVAC system (Example, API)



Questions?

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