



Sensing the Future: On-Board HVAC Diagnostics

2019 Residential New Construction Partner Meeting
September 11, 2019

Alternative Compliance Paths

- Primary goal of working group is to define a standard for Raters to assess HVAC design and installation.
- There's a placeholder in Std. 310 for alternative compliance paths in addition to the Rater-verification path.
- One possible pathway is on-board diagnostics. For example, an on-board diagnostic system might assess any or all of the following:
 - Actual system airflow
 - Actual fan wattage
 - Non-invasive data points or equivalent



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Agenda

- My odd perspective
- Industries are changing, and fast!
- Trades are important
- Sensors in HVAC and why it matters
- The future of HVAC installation and maintenance

The industry today.



HVAC TECH SHORTAGE

Conservative estimates put the industry HVAC tech shortage at 20,000



OVER 40% of newly installed residential systems are not installed correctly



OVER 70% of home systems are inefficient or heading for a breakdown



UNDER 10% of maintenance agreement systems are properly serviced



A smarter solution.

SMART HVAC WITH 24/7 MONITORING.

How it works



SMART SENSORS OFFER A TOTAL SENSE OF COMFORT. Custom sensors gather vital, never before seen information every time a system runs. The data is sent to our monitoring center's secure cloud over your customer's home Wi-Fi network.



24/7 MONITORING FOR UNPRECEDENTED INSIGHT. Our team carefully monitors data every time a system runs. In most cases, we detect an issue before it becomes a problem.

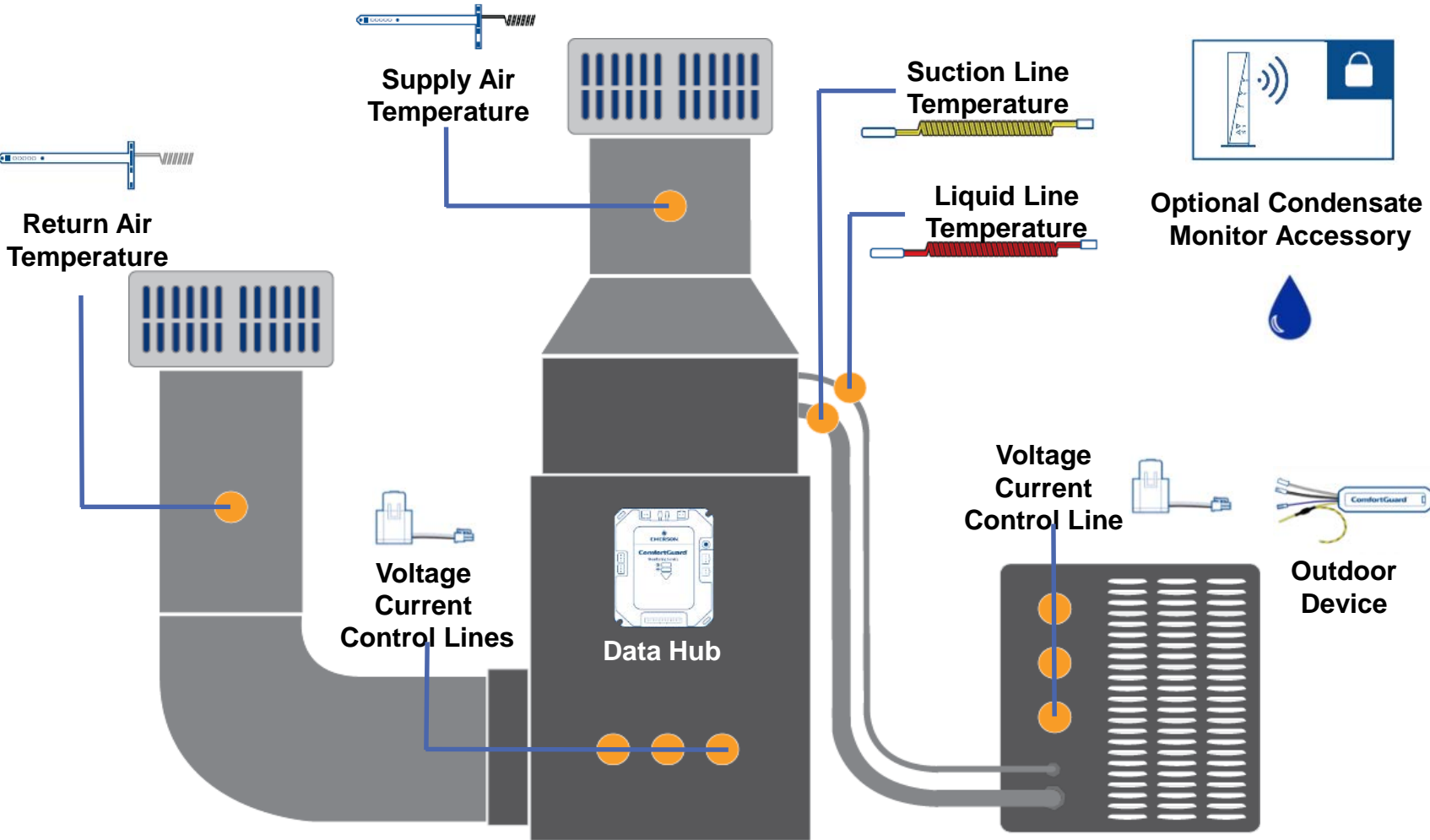


STAY IN THE KNOW AND KNOW WHAT TO DO. By sending you and your customers timely communications including system reports, actionable alerts and repair verifications, you differentiate yourself from your competition.

The Install Problem Is Real



Hardware Consists of 10 Sensors Plus Data Hub



What the Technician Sees – At the Installation



sen|si
Connecto Comfort

A/C System Snapshot 12/20/2018, 4:51:17 PM

Outdoor Measurements	Indoor Measurements	System Info & Weather Data
Low Pressure (psig): 118.0 (70.0)	Return Temp (°F): 75.0	System Load: 3.0p
High Pressure (psig): 350.0 (106.8)	Return RH (%): 23.0	Return Airage Energy: 2.0
Suction Line Temp (°F): 39.5	Return Air U-Ins (°F): 62.4	Refrigerant: 4.00k
Liquid Line Temp (°F): 86.0	Supply Temp (°F): 69.0	Return Airflow: 400
Outdoor Air Temp (°F): 19.0	Supply ACH: 0.10	SEER: 13.0
Outdoor Air Temp (°F): 19.0	Supply RH (RH): 21.7	Heating Degree: 7.0
Superheat (°F): 10.5	21 Low Pressure (PSIG): 75.0	Amperage (Phase A): 14.00
Subcooling (°F): 11.8	21 Low Pressure (PSIG): --	Phase (°): 48.0
Compressor Power: 218	Total Filtered Stack Power (kW): 3.8	Temperature (°F): 48.0
Outdoor Voltage: 200.0	AHU Voltage: 110.0	Ind. RH (%): 98.0
Outdoor Amperage: 7.0	AHU Amperage: 3.0	Exit RH (%): 94.0
Outdoor Power Factor: 0.95	AHU Power Factor: 0.90	System Stability: Unstable
Outdoor Power (kW): 140.0	AHU Power (kW): 0.14	

Capacity Calculations	Air-side Performance
Rated: 2.0 tons / 24,000 Btu/h	onside S&T (gph): 19.4
Actual: 1.6 tons / 22,200 Btu/h	onside S&T (gph): 20.0
SEER: 13.0 tons / 15,600 Btu/h	onside S&T (gph): 27.0 gph
SEER: 13.0 tons / 15,600 Btu/h	onside S&T (gph): 0.7 gph
SEER: 13.0 tons / 15,600 Btu/h	onside S&T (gph): 0.1
SEER: 13.0 tons / 15,600 Btu/h	onside S&T (gph): 0.7
SEER: 13.0 tons / 15,600 Btu/h	onside S&T (gph): 2.5
SEER: 13.0 tons / 15,600 Btu/h	onside S&T (gph): 4.0

Customer	Whole Home
123 Test St	Conditioner
Unit 5	Phase: F104
San Jose, California 91034	Serial: 1234567890
john@sen.com	Air Handler
555-150-4321	Phase: F104
	Serial: 1234567890
	Evaporator
	Phase: F104
	Serial: 1234567890

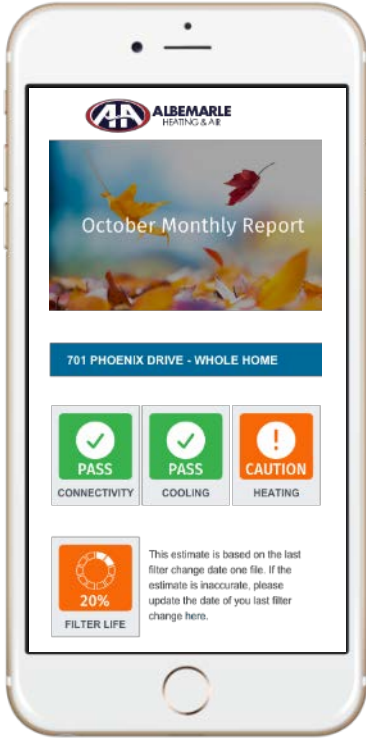
powered by **measureQuick**

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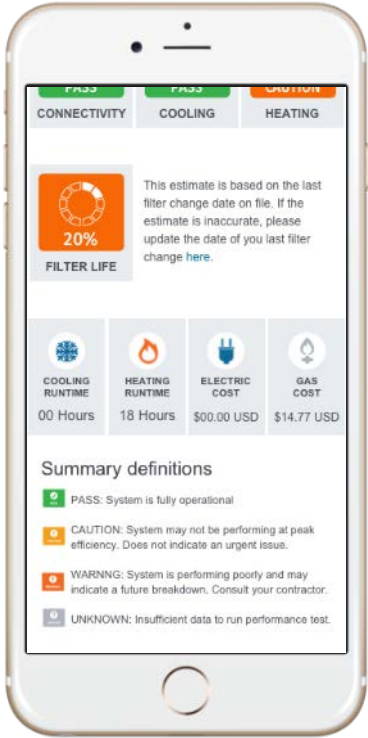


Monthly Report

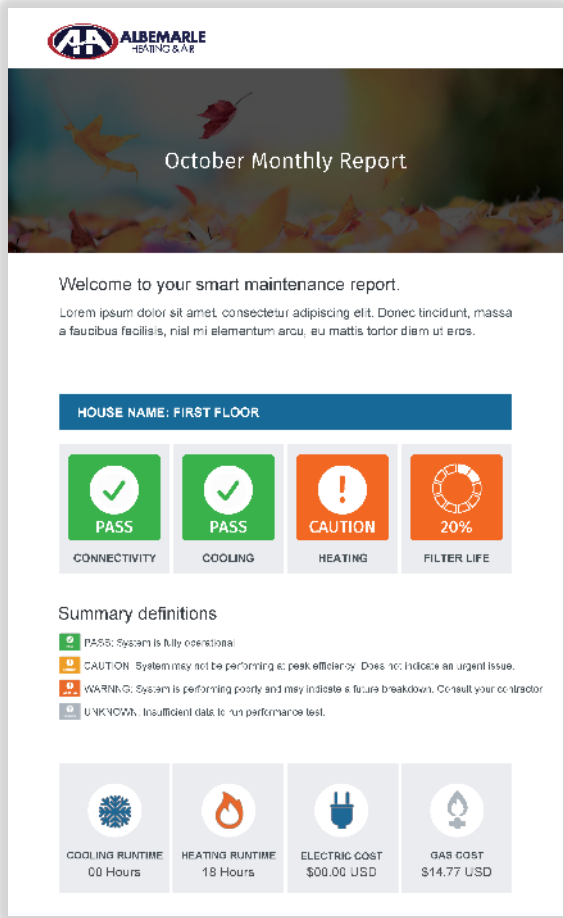
Performance Check



Runtime & Cost



Desktop Version



Jim Fisher

Director – Product Marketing - Residential Controls

Goodman / Amana

ComfortBridge™ Controls System

CoolCloud™ Bluetooth® Application



- What is it? -



EXPANDABLE SIMPLICITY

APPLICATION FLEXIBILITY

\$ FRIENDLY SOLUTIONS

ComfortBridge™ technology



A dark blue rounded rectangle containing the Bluetooth logo on the left, the CoolCloud™ logo in the center (which includes a cloud with a speech bubble and a person icon), and a blue HVAC unit on the right.



Two Unique Characteristics

ONE

Staging

Stages Equipment

- **Modulating Furnaces**
- **2-Stage Furnaces**

- **Variable Speed Inverter Air Conditioners and Heat Pumps**
- **2-Stage Air Conditioners and Heat Pumps**

New Control Arrangements



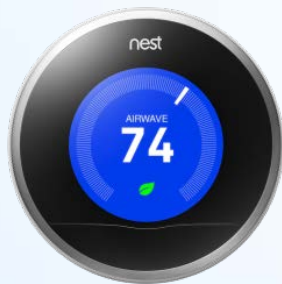
Thermostat

*The contractor
chooses the control.*

Unrivalled Thermostat Compatibility



Give people what they want!



New Control Arrangements



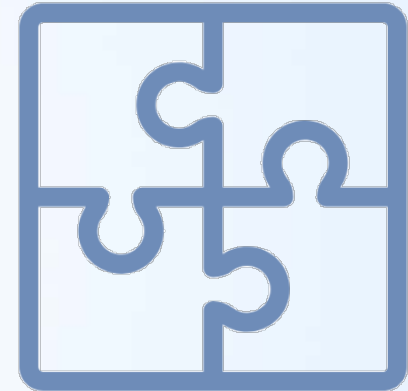
Thermostat

The contractor chooses the control.



Accessories

No limitations to what can be connected.



Zoning

Your choice is our choice.

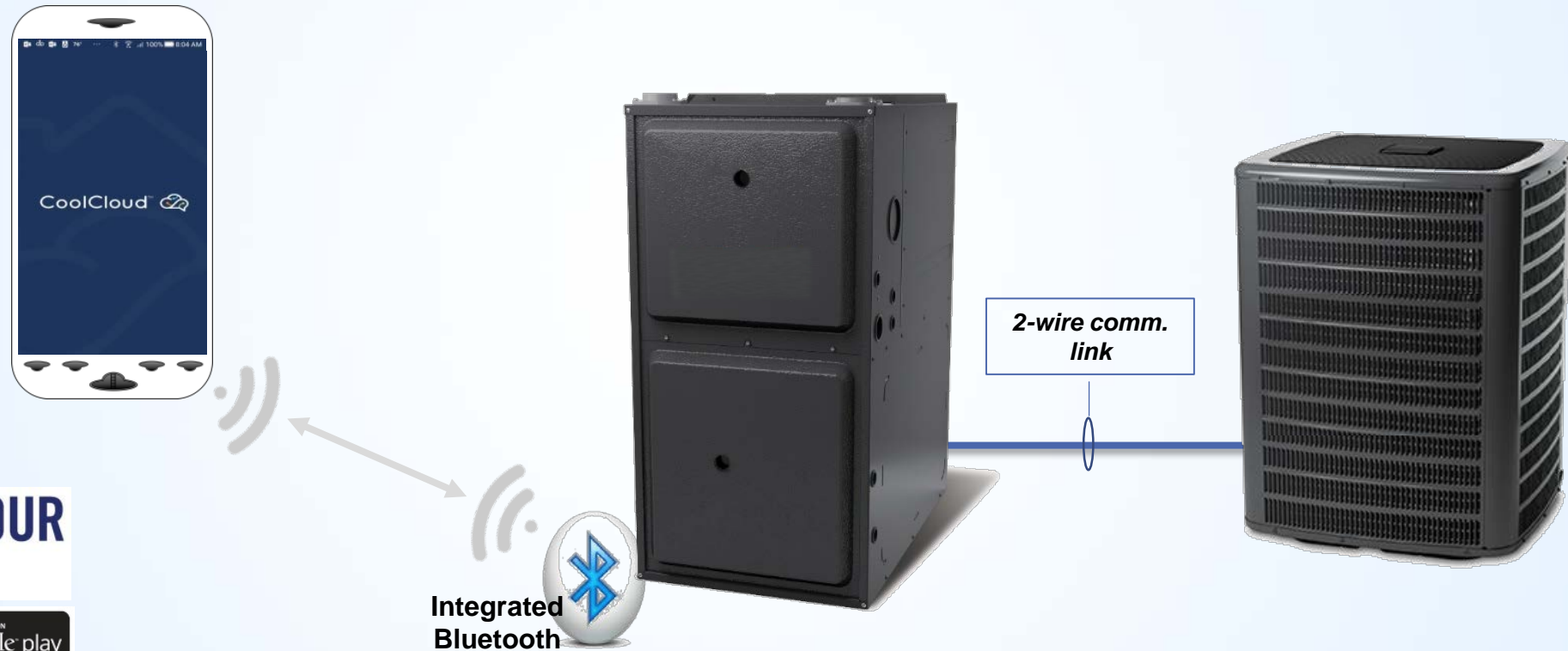
Two Unique Characteristics

TWO

User Interface

- Access to Advanced Menu
- Advanced User Menus
- Configuration and Diagnostic Menu Access

Onboard Bluetooth - CoolCloud



**DOWNLOAD OUR
FREE APP**



A photograph of a modern building with a dark grey facade and light-colored horizontal siding. A large, semi-transparent red rectangular overlay covers the middle portion of the image. The text "THE FUTURE" is centered within this red area in a white, bold, sans-serif font. The sky above is a clear, light blue with some wispy clouds.

THE FUTURE



Thermostat Lifespan

The Future of Thermostats

- 5 years?
- 10 years?
- 15 years?

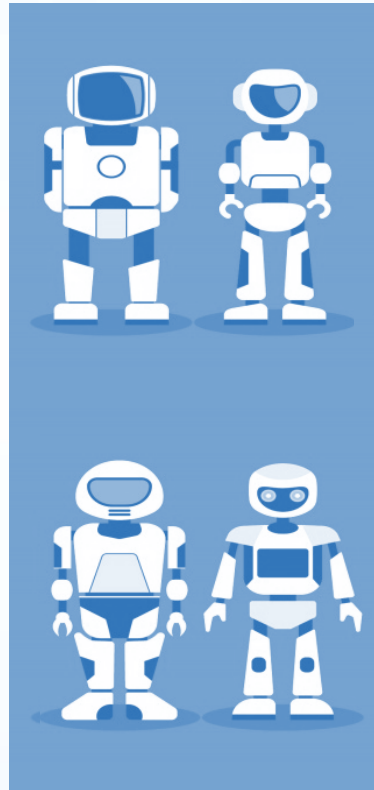
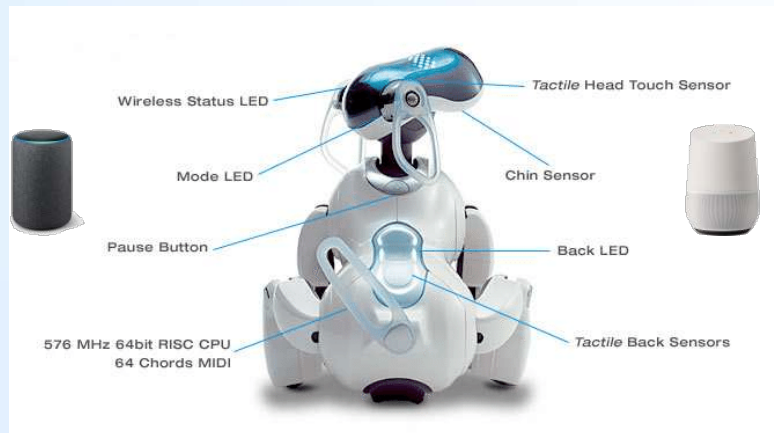
What Will Replace?

- Sensors?
- Algorithms?
- Home automation?
- Voice activated devices?

Sensors

Robots and Sensors

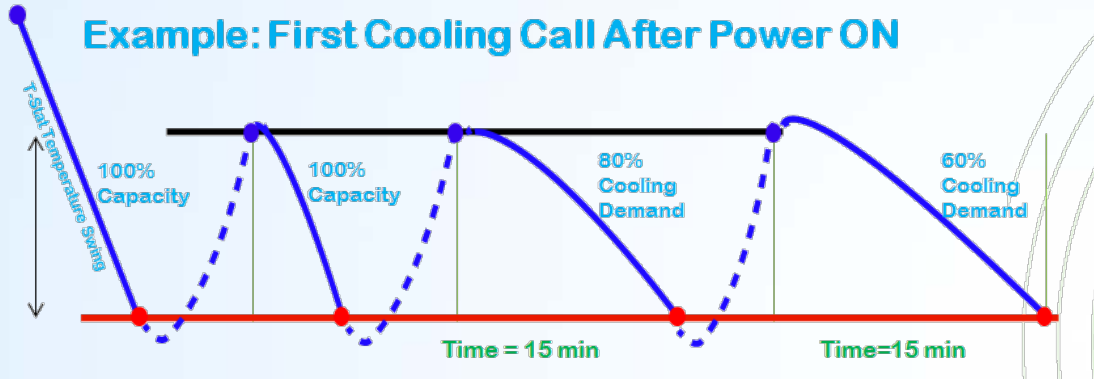
- Connectivity
- Video
- Home automation hub
- Touch
- Voice
- Indicator LEDs



Sensor Options?

- Internal?
 - Onboard / integrated
 - Return air based
- External?
 - Supply air
 - Room sensors
 - Temperature
 - Humidity
 - IAQ
- Both?

Algorithms



Good Algorithms

- Should produce the correct outputs.
- Should execute efficiently.
- Should be understandable.
- Should be modifiable.

Algorithms

- A computer procedure a lot like a recipe.
- Tells hardware (via a computer) precisely what steps to take to solve a problem or reach a goal.



Smart Home



Home Automation

Temperature Control

- Is it pulled into the smart home?
- Thermostat companies are smart.
- Will they control the next wave of temperature control?
- Will there be new players?

Voice Technology



Voice / Speech Activated Control

- Voice recognition provides speech-enabled technology interaction.
- We have the ability to receive and interpret spoken commands.

How Voice-User Interfaces (VUI) Work

- A VUI makes interaction with computers possible.
- Speech recognition understands spoken commands and questions.
- VUIs will provide input through home automation using sensor and algorithm data outputs.

A photograph of a modern two-story house with a grey and white color scheme. The house features a prominent gable roof with a central window, a front porch with a red door, and a two-car garage. The house is surrounded by a well-maintained lawn with several green shrubs and a concrete walkway leading to the front door. A teal semi-transparent banner is overlaid across the middle of the image, containing the text "WHAT IT MEANS" in white, bold, uppercase letters.

WHAT IT MEANS

Future Path

- **How will the change occur?**
- All at one time?
 - Killer app
- Incrementally?
 - Sensors and algorithms added over time.
 - May even be happening now!

What is the Impact?

**Equipment
Manufacturers**

**Thermostat
Manufacturers**

Contractors

Consumers

Equipment Manufacturers

Equipment is OK 👍

- **Big Question: How to cover the cost?**
 - Technology driven (A2L Implementation / FER / ULN)?

Controls Portfolio Expansion

- **Recurring Revenue**
 - Equipment monitoring (sensor integration)
 - EOL opportunities
 - Owned by the consumer
 - Pushed to contractor with homeowner's permission
- **Equipment Leasing**
 - Prominent in Canada
 - US utilities dipping their toes in the water
 - Could be managed by utilities, OEMs or private leasing



Thermostat Manufacturers

Portfolio Expansion Likely

- Move away from hardware?

Hardware Alternatives

- Will thermostat manufacturers command software superiority?
- Will they create strength through their experience with sensors, algorithms and data management?

Other Product Opportunities

- Thermostat manufacturers have already shown interest in other areas like home automation.
- Hard to dethrone the kings
 - Google / Amazon

Google

amazon.com

What is the Impact?

Contractors

The Future is Change

- Market pressures will dictate changes in the commerce chain.
- Economy could accelerate or impede changes.
- There will always be a need for qualified installers / technicians.

Consumers

More In Charge

- The consumer is the home gatekeeper.
- The consumer owns the data.
- They provide permission allowing for data collection outside of the home.

The Future is Interesting!



Thank You