Retailer Trends in Distributed Controls and Electronics

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Discussion Topics

Introduction	What's the difference?	Distributed vs. Central (or both)	What do I need to plan for in the future?
Background and evolution of control systems	What are the different architecture "layers" of a control system?	What are the key differences and similarities of the different control architectures? What are the benefits?	Is it possible to "future proof" my systems?

Discussion Topics

Introduction

Background and evolution of control systems

What's the difference?

What are the different architecture "layers" of a control system?

Distributed vs. Central (or both)

What are the key differences and similarities of the different control architectures? What are the benefits?

What do I need to plan for in the future?

Is it possible to "future proof" my systems?

Definitions

Energy Management System (EMS)

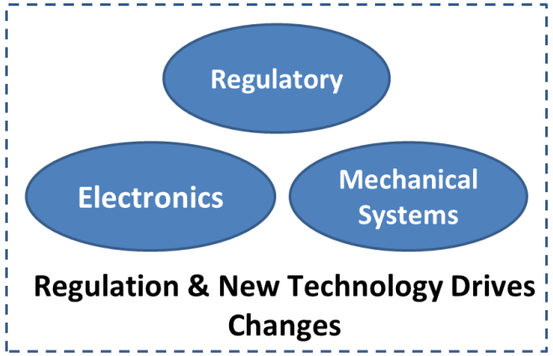
Building Automation System (BAS)

Facility Management System (FMS)

Building Management System (BMS)

- Slight differences in meaning across industries
- Generally, BAS implies broader integration, while EMS implies focus on energy management
- Refer to a collection of hardware and software to monitor and control the mechanical, electronic and lighting systems
- Installed at a single site
- For our purposes, these are the same thing

Multiple Factors Drove Evolution of Control Systems From Mechanical to Electronic Systems

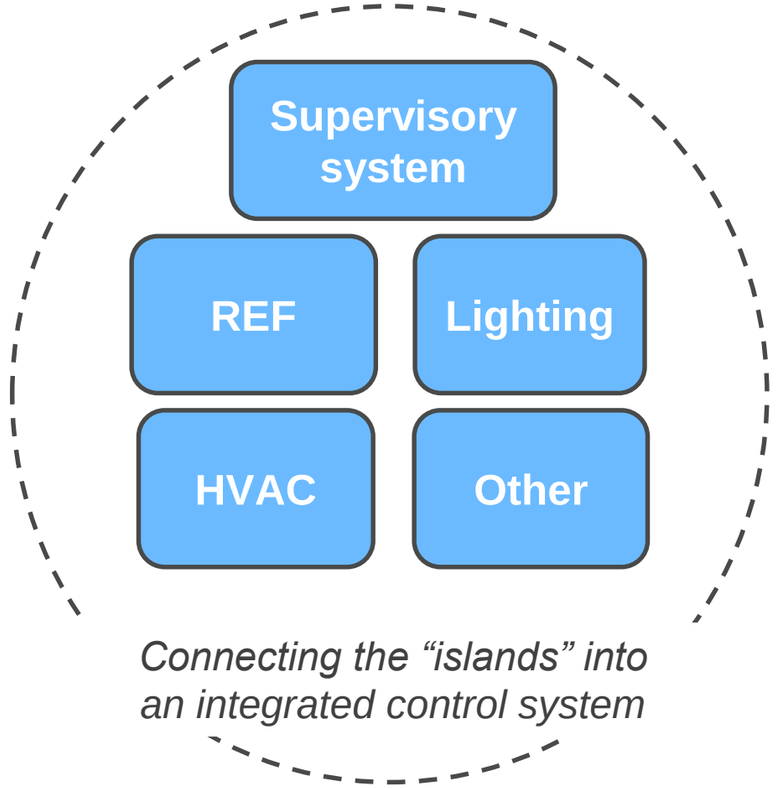


- Early refrigeration systems transitioned from “refrigerators” to rack-based systems
- Mechanical control systems operating independently
- Adjustments made directly on equipment
- Difficult to “tune” or optimize
- No “cross-system” integration or optimization
- Limited temperature monitoring

- Advances in sensing technology and electronics enable cost-effective electronic controls
- Electronic platforms enable improved control and optimizations for energy and maintenance
- Regulatory drivers force energy and refrigerant considerations
- Case temperature monitoring for food safety and compliance

Systems Evolved From “Islands of Control” Integrated to Form a Complete Integrated Control System

- Individual systems tied together
- Information sharing across systems
- Emergence of “supervisory functions”
- Integration/Control maturity similar to auto industry evolution
  - Communication technologies
  - More sensors
  - Smarter control
  - Use data to drive actions



Connecting the “islands” into an integrated control system

Evolution and progress

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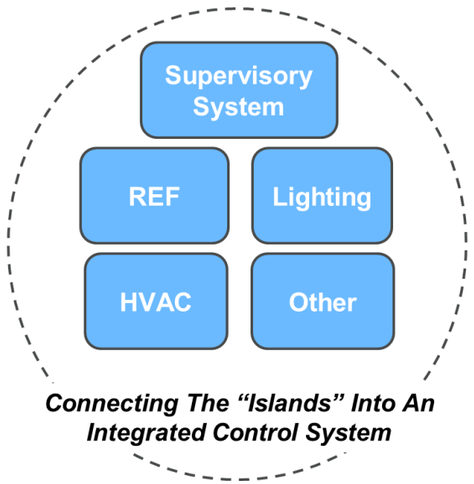
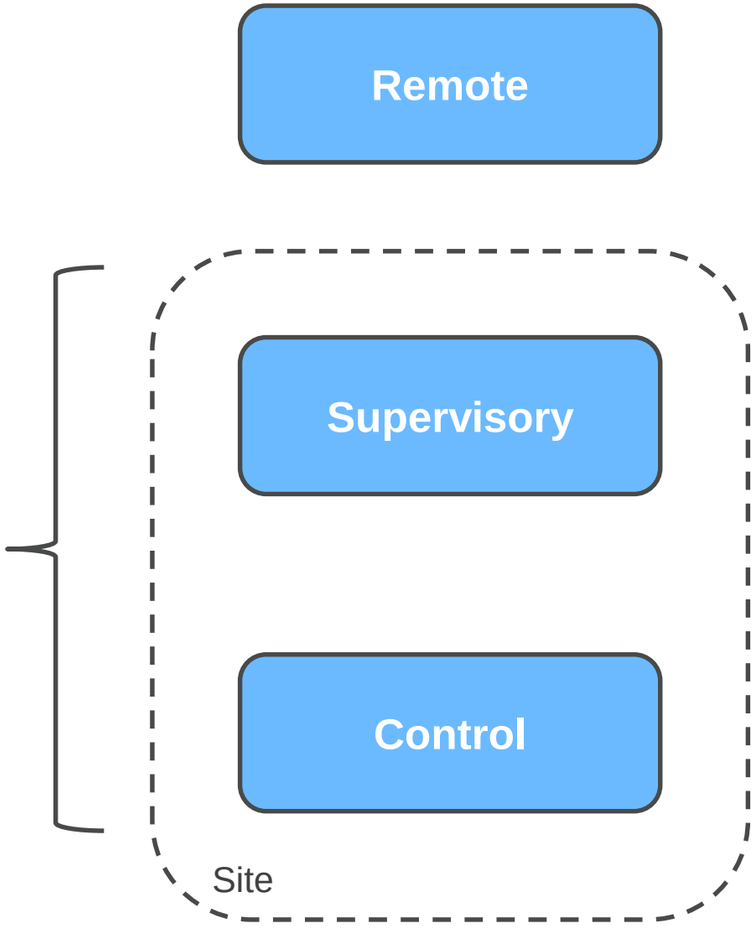
Layers and Functions of a Control System



Connecting The "Islands" Into An Integrated Control System

Architecture layer



Hardware Can Be Combined or Separated

Key elements

- Remote user interface
- Site information
- Data feed

- On-site user interface
- User management
- Data logging
- Alarming
- Cross-system coordination

- Control algorithms
- Inputs and outputs
- Sensors and transducers
- Equipment interface

Integration and Communication Capability Key Part of BMS

Supervisory layer normalizes information to provide alarms, data logs, etc.

Architecture Layer

- Remote
- Supervisory
- Control

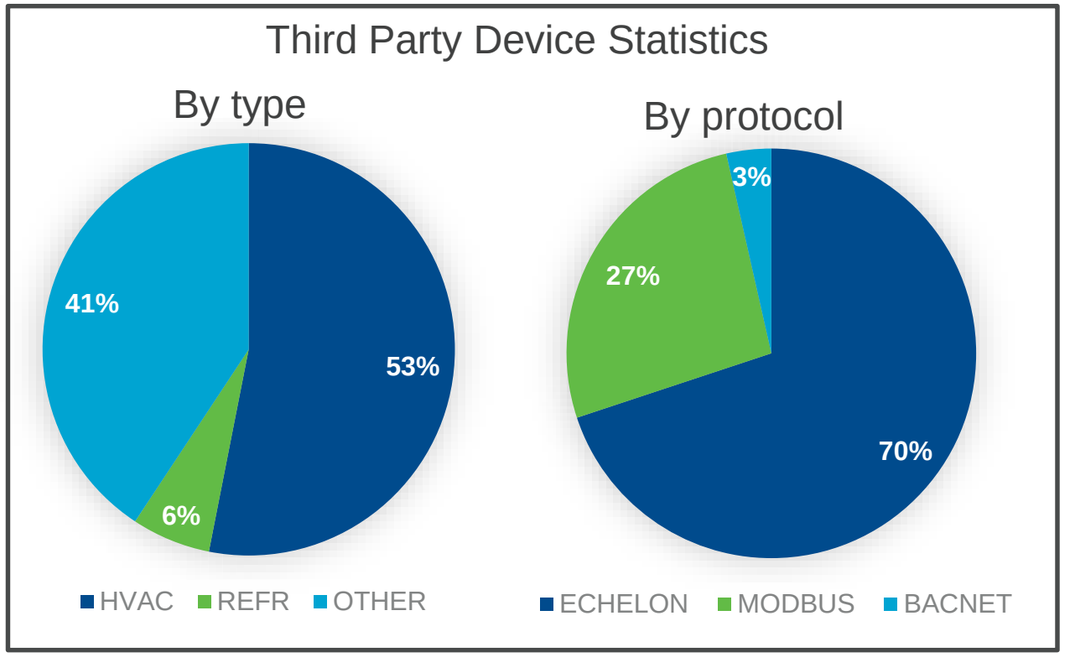
BMS

- Core HVACR/L
- Third Party Devices

Water heaters, energy meters, car chargers, breaker panels, etc.

Benefits

- Common user interface across site
- Remote access
- Normalized information (alarms, logs, etc.) using operational visibility



Note: Statistics based on Emerson's E2 support (113 devices)

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Distributed Control Systems — The Technical Definition

WIKIPEDIA
The Free Encyclopedia

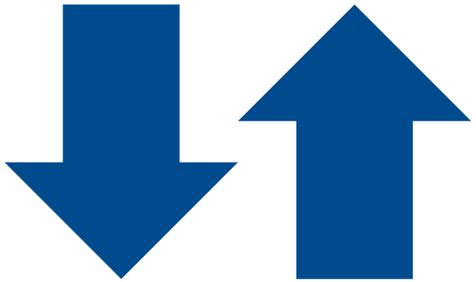
Distributed control system

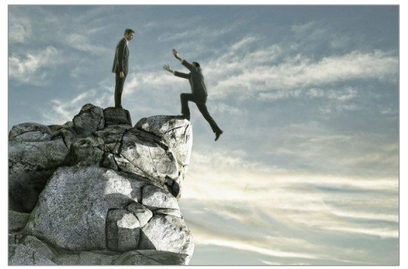
From Wikipedia, the free encyclopedia

A **distributed control system** (**DCS**) is a computerised control system for a process or plant, in which autonomous controllers are distributed throughout the system, but there is central operator supervisory control. This is in contrast to non-distributed control systems that use centralised controllers; either discrete controllers located at a central control room or within a central computer. The DCS concept increases reliability and reduces installation costs by localising control functions near the process plant, but enables monitoring and supervisory control of the process remotely.

Distributed control systems first emerged in large, high value, safety critical process industries, and were attractive because the DCS manufacturer would supply both the local control level and central supervisory equipment as an integrated package, thus reducing design integration risk. Today the functionality of SCADA and DCS systems are very similar, but DCS tends to be used on large continuous process plants where high reliability and security is important, and the control room is not geographically remote.

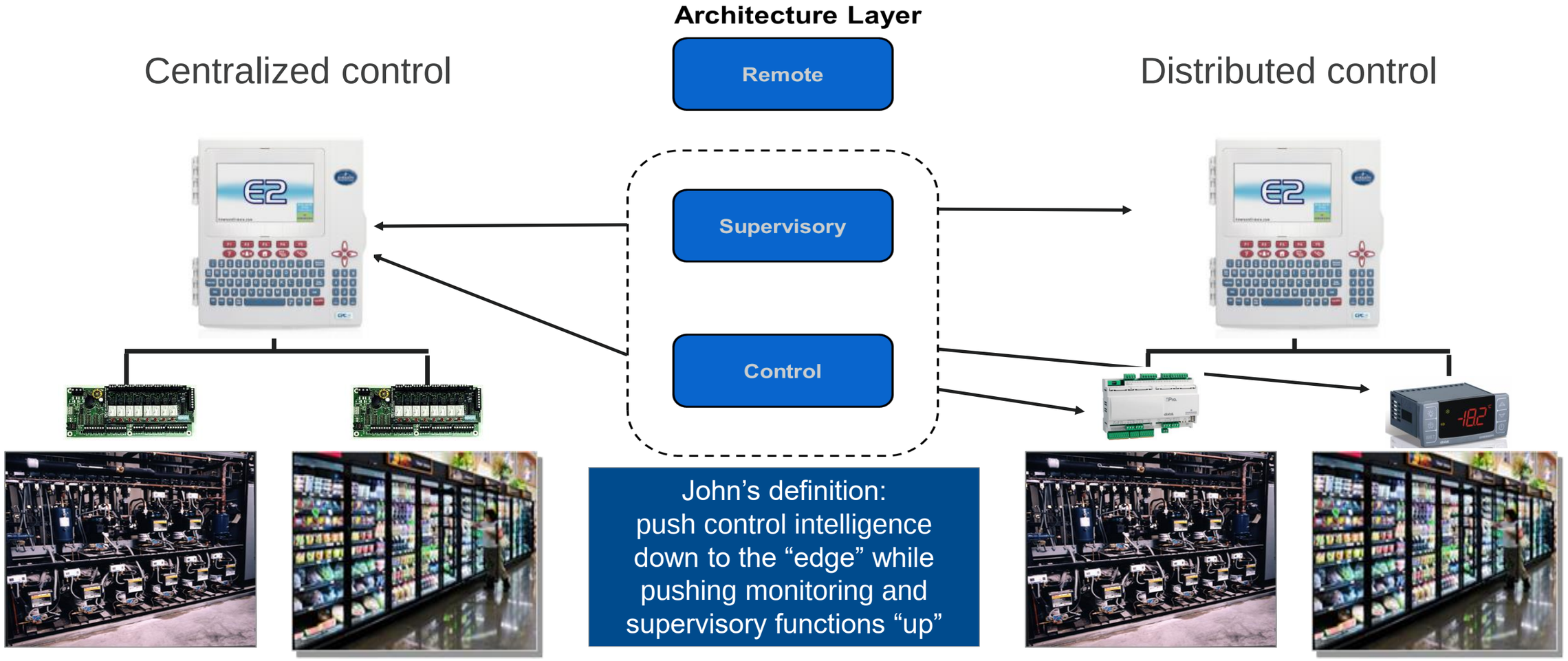
John's definition:
push control intelligence down to the "edge" while pushing monitoring and supervisory functions "up"





Source: Wikipedia https://en.wikipedia.org/wiki/Distributed_control_system

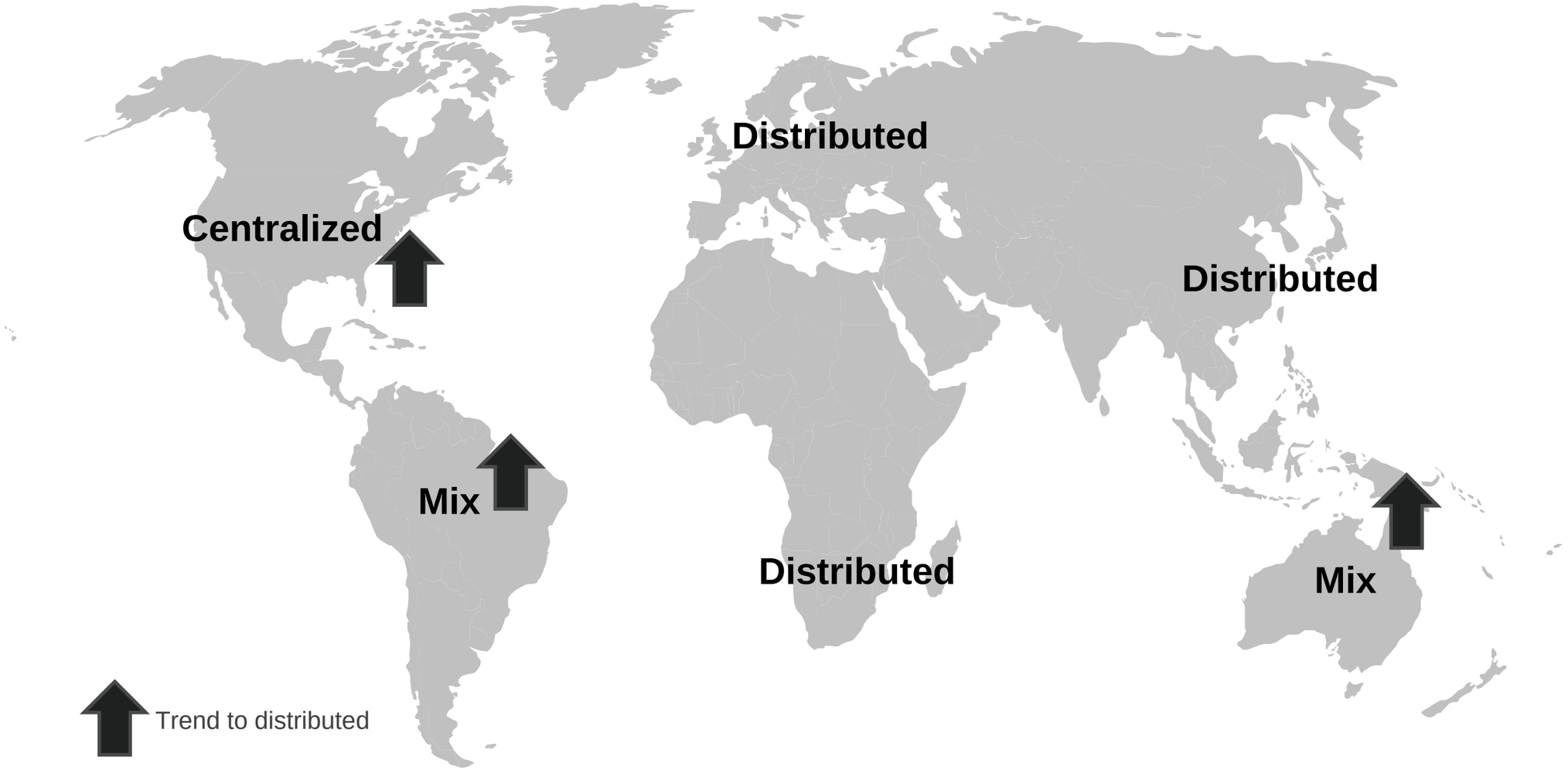
Distributed vs. Central: A Familiar Example



- Control algorithms run ***in*** centralized E2
- I/O boards utilized for inputs, relays

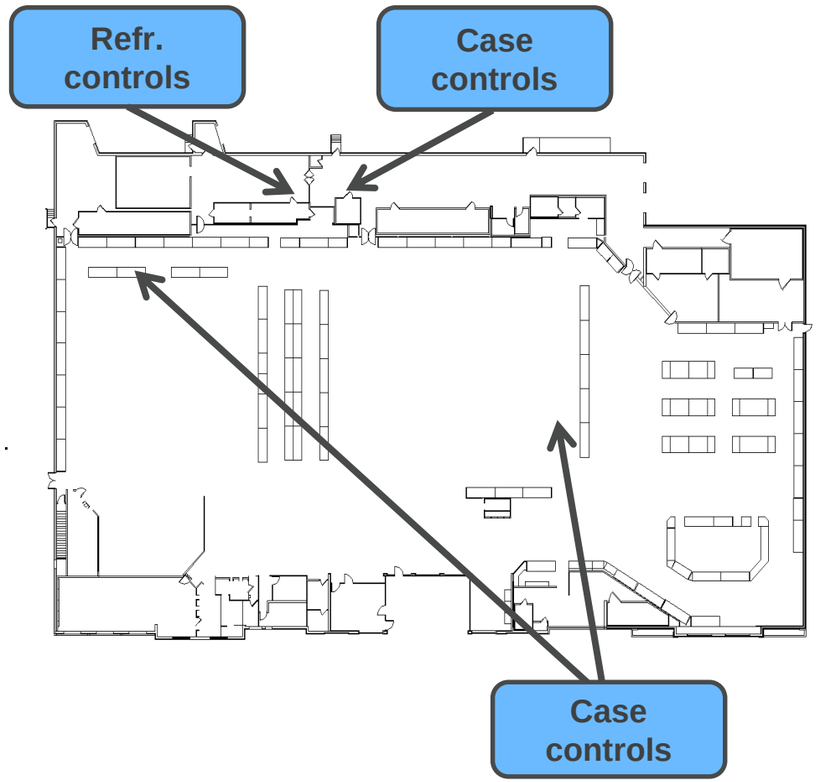
- Control algorithms run ***in*** distributed controllers
- Communication to E2 for supervisory functions

Predominant Refrigeration Control Architecture Varies by Region: CO_2 Impacting Future



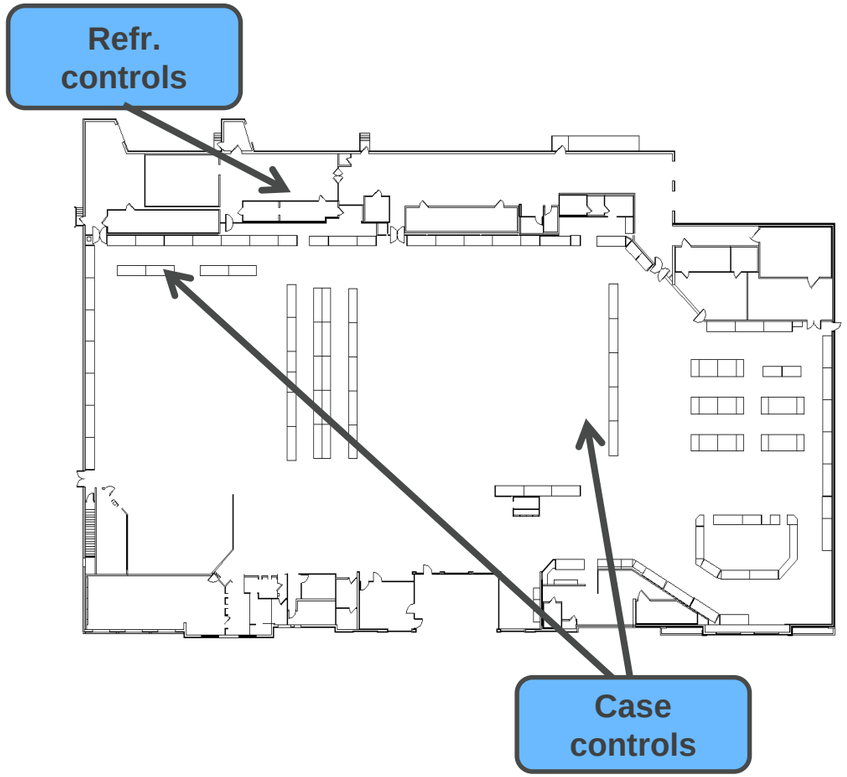
Comparison of Refrigeration Control Architectures

Centralized control architecture



- Control elements centralized at refrigeration rack or electrical panel
- “Home runs” for sensors
- “I/O” boards for control

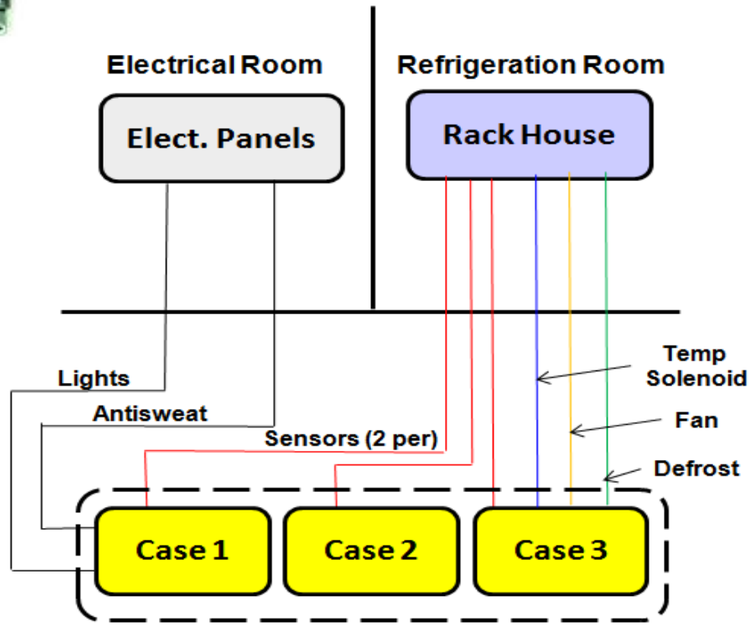
Distributed control architecture



- Control elements at case
- Communication “daisy chain” to EMS
- Complete control at refrigeration case
- Case electronics for control

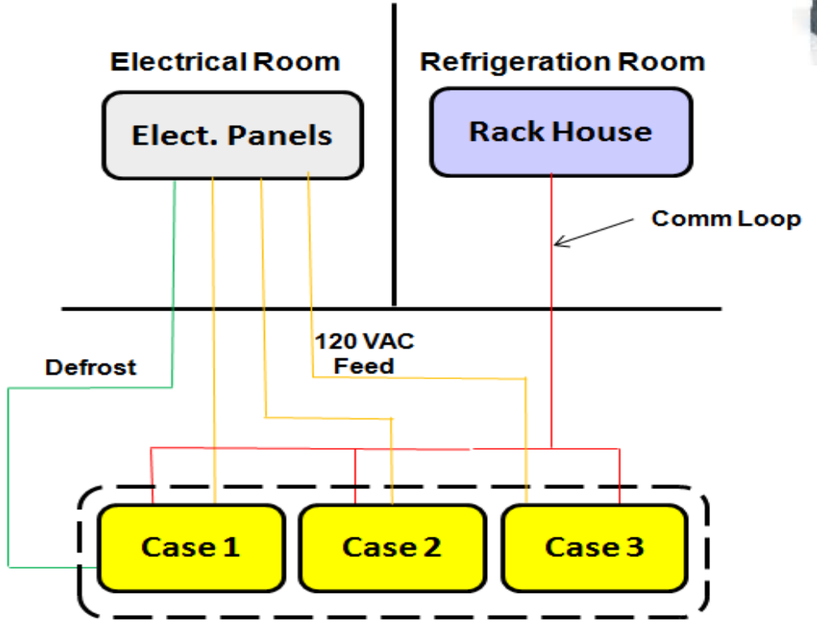
Distributed Case Control Shifts Electronics From Electrical/Rack Rooms to Case and Simplifies Wiring

Centralized control



	Rack	Case
Sensors		✓
Input Boards	✓	
Relay Boards	✓	
Case Electronics	N/A	N/A
EEV	N/A	N/A

Case control



	Rack	Case
Sensors		✓
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Relay Boards	N/A	N/A
Case Electronics		✓
EEV		✓

Distributed Control Change Impact: Better Control With a Completely Integrated System

Four rack controllers

Rack control

Four rack controllers,
but reduced functionality

200+ mechanical valves
(self-managed)

Valves (EXV and EEPR)

250+ electronic valves
and pressure sensors

Mechanical valve (no intelligence)

Expansion valve control

100+ controllers (1:1)
(we control and drive the valve)

Eight control boards
(centralized controlled)

Evaporator valve control

Controllers will manage valve
(one per lineup; we control
and drive the valve at cases)

Purely controls solution and system
not integrated (valves are not managed)

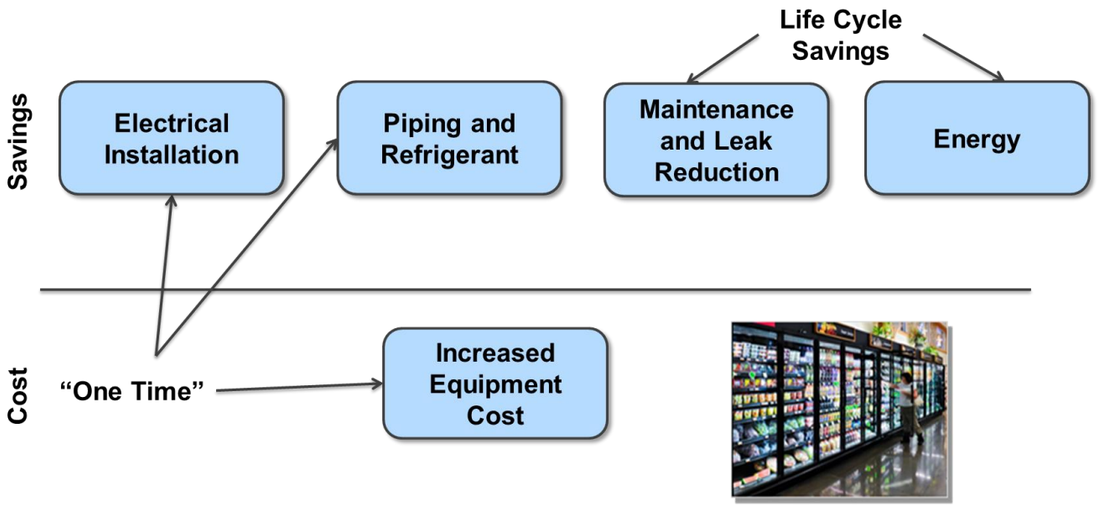
“The solution”

Fully integrated system
solution

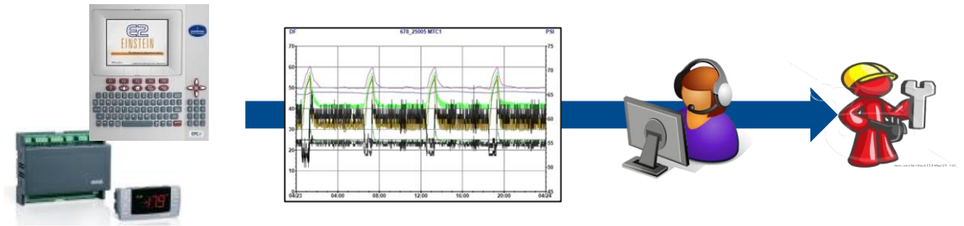
System Integration Capabilities and Domain Knowledge Key to Successful Deployment

Distributed Control Benefits

- OEM/equipment providers can factory install and test to deliver a complete working system
- Broader integration delivers more value to end user
- Reduced field wiring and startup time
- Technology flexibility allows best “fit” solution
- Additional sensors provide more data for remote troubleshooting
- Lifecycle cost advantage



Lifecycle cost considerations for distributed case control



Sensors feed data analytics to facilitate cost optimization

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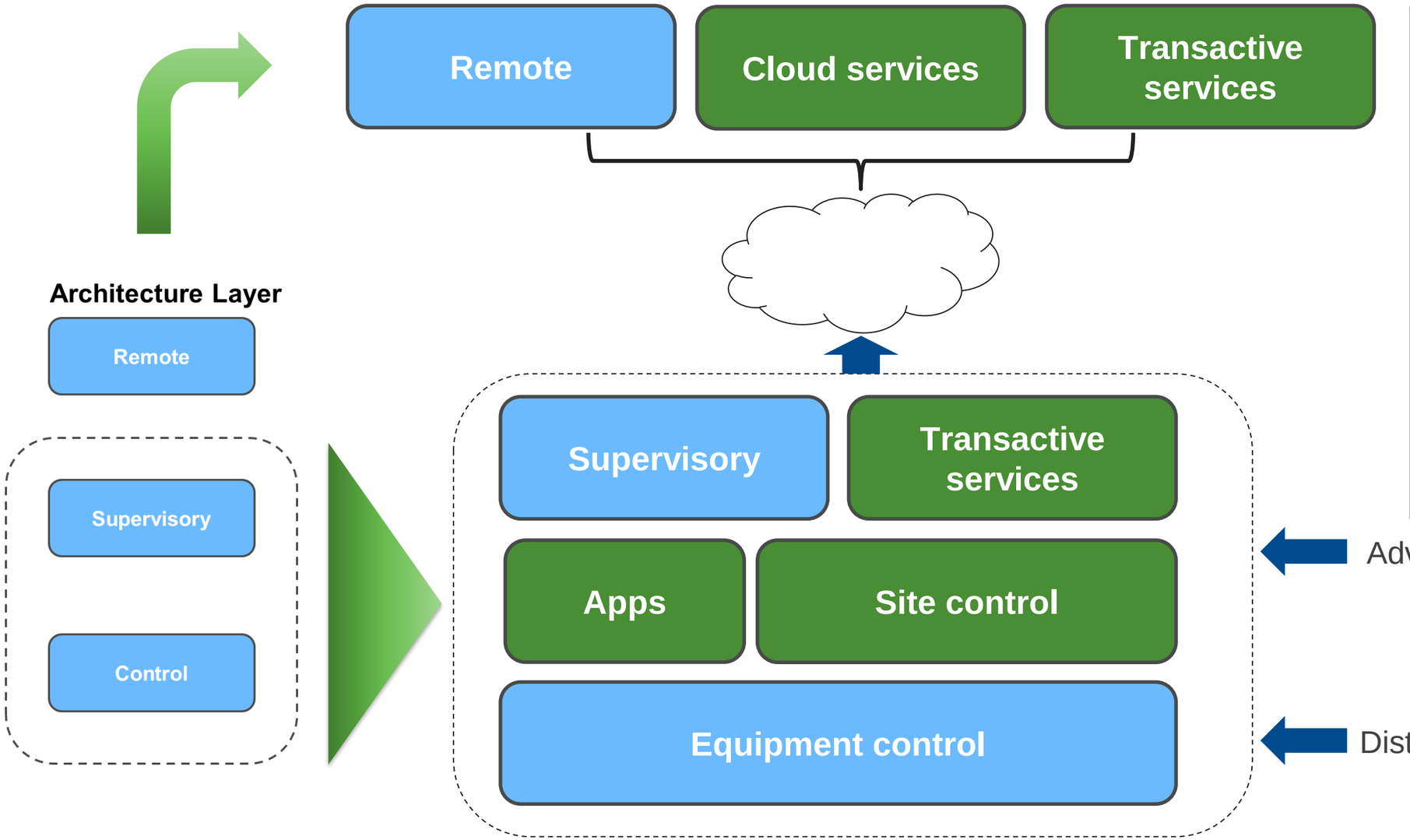
Planning for the Future: Newer Systems Need Flexibility and Advanced Control to Create Smarter Buildings



- "Traditional" control architecture expanding to enable more value
- Flexibility provided by add-on "apps" which facilitate customized solutions
- Site control provides macro level control and coordination of equipment on a cross-site basis (i.e., HVAC/R)
- Transactive services provide opportunity to utilize "smart grid" as well as other cloud-based services (i.e., renewable integration, etc.)

Discussion Summary and Questions

- Global trends driving distributed control architecture transition
- Hybrid systems (i.e., case controllers with centralized rack control) are common and familiar
- Benefits include factory test, reduced startups and potentially lower lifecycle costs
- System integration capabilities as well as domain expertise key to seamless transition and creation of integrated solution
- Advanced capabilities (cloud, transitive, machine learning, etc.) drive need for advanced, flexible BMS which can be utilized with distributed controls

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Thank You!

Questions?

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