

Building Controls:

Finding the Right Fit for Your Facility

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Today's Moderator



Naomi Millán

Senior Editor

building
OPERATING
management

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Today's Presenters

Rob Knight



Maria Lupo



Environmental Systems Design, Inc.

Rob and Maria work in the Controls group at ESD, where they support the MEP engineering practice with the design and specification of vendor neutral, open protocol, state of the art building automation systems and integrated building management systems for high-performance commercial buildings, both at home in Chicago and across the globe. Rob, Maria, and their team also consult direct to building owners and operators, to provide solutions including controls retrofit master planning, enterprise integration planning, energy optimization strategies, and performance enhancement.

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Learning Objectives:

- Understand the basic building automation system strategies that every facility manager should implement
- Comprehend higher level building automation system functions and how they can benefit a facility
- Learn how to achieve energy savings and sustainable facility operations with building automation systems

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To ask questions:

Please use the question and answer panel on the right-hand side of the screen, and send to all panelists.

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Polling Questions

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Presentation Handouts

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Answers for infrastructure.

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How do we maximize efficiencies, keep everyone comfortable and stay within our budget?





Where do I find someone who understands all of my building systems?

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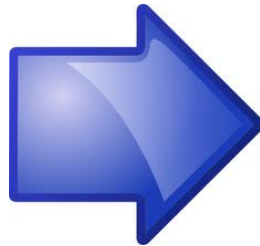
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- Level-set / describe “the modern BAS”
- Simple steps to get started
- Features you *might* be able to add easily



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- **Level-set / describe “the modern BAS”**
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Level-set

- Why BAS?
- BAS types and application per market
- Common elements of modern BAS
- Differentiators of modern BAS
- Discuss integration



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Why BAS? Why are we here?

- Energy efficiency
 - Share data
 - Programming changes
- Enhance operation effectiveness
 - Relevant data to operators – manage by exception
 - Find patterns in data
- Assure comfort and reliability
 - Energy = \$2/sq. ft. Salary = \$200/sq. ft.

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BAS Types

- BAS – Building Automation System
- BMS – Building Management System
- EMS – Energy Monitoring / Management System
- EPMS – Electrical Power Monitoring System
- FMS – Facility Management System
- IBMS – Integrated Building Management System
- PLC – Programmable Logic Controller
- DCIM – Data Center Infrastructure Management

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Market Specific Drivers

- Mission Critical – power monitoring, DCIM, reliability
- Healthcare – life safety, flexibility, regulatory compliance, reliability
- Commercial Office – cost, energy, flexibility
- Enterprise Owner / Campus – compatibility



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So Which One is Right for Me??

- The acronym doesn't matter!
- Decide what things you need to connect / integrate
- Decide the features and functions you need for operating
- Find a solution provider able to meet your needs
- The lines are grey....

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The Modern BAS

Common Elements

- Protocols
- Interface
- Powerful
- Backbone
- Scale
- Common IT standards
- Integration

Differentiators / Choices

- Security
- Solution providers
- Architecture
- Contracting methods
- Package vs built-up controls

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Protocol Support

- Open protocols are default – BACnet, LonWorks, Modbus
- In North America, BACnet (an ASHRAE standard) seems to be defacto standard for HVAC
- Elsewhere, not so clear (Lon, KNX)
- But Middleware means it's less important – mix and match with a “protocol agnostic” solution
- Electrical gear = Modbus
- Lighting is up for grabs, circa HVAC in 2001 – DALI, proprietary / closed, KNX, BACnet
- Wireless can be a mess – which Zigbee? Proprietary mesh? PTP?
- Methods for integration to closed / proprietary protocols exist, but beware poor performance



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Web Interface

- Web Interface (thin client) is here to stay
- Thick client software still has value in some instances
- But for many more instances, the web browser will suffice
- This means flexibility for you – operate from home, from the CEO's office, on a laptop near the AHU
- Tablets and smart phones have increased rapid pace of adoption



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Powerful

- Processing and memory is rarely a bottleneck at the controller
- Programmability is usually possible in any form factor
- Special function blocks replace difficult (or impossible) sequence programming



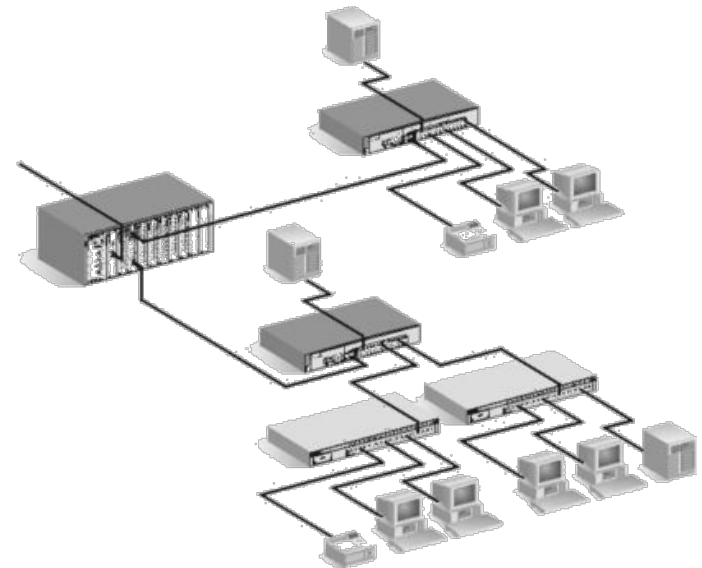
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Ethernet Backbone

- Backbone commonly Ethernet / TCP/IP
- Various protocols used across backbone – Ethernet / TCP/IP don't guarantee interoperability
- Two strategies:
 - Stand-alone BAS network
 - Enterprise / Owner / IT Dept. network



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IT Standards

- Leverage all the technology, spending, research from IT
- Network and protocols (including WiFi)
- Mobile: tablets and smart phones
- Databases / enterprise applications
 - SQL / Oracle
 - Open API
- Let IT provide and manage what they know well: servers, email, firewall, network security



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Scale

- Typically very flexible – single equipment to global enterprise
 - Equipment w/ embedded web pages
 - Single NC
 - Multi-NC / single server
 - Multi-tiered server (regions / continents / cities, etc.)
- Web interface can mean additional users
- 3rd party applications can mean additional consumers of data

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Integration

- Wide topic, more to follow....
- Typical modern BAS can handle quite well
 - Subsystem integration
 - Interoperable on “the same wire”
- Typical modern BAS doesn’t do much
- But there isn’t a “typical” subsystem or equipment to integrate to
 - each still custom
- Still wise to define the scope of integration deliberately
 - Worthwhile to replicate a vendor’s software completely?
 - Or better value to follow 80/20 rule – integrate the 80% stuff

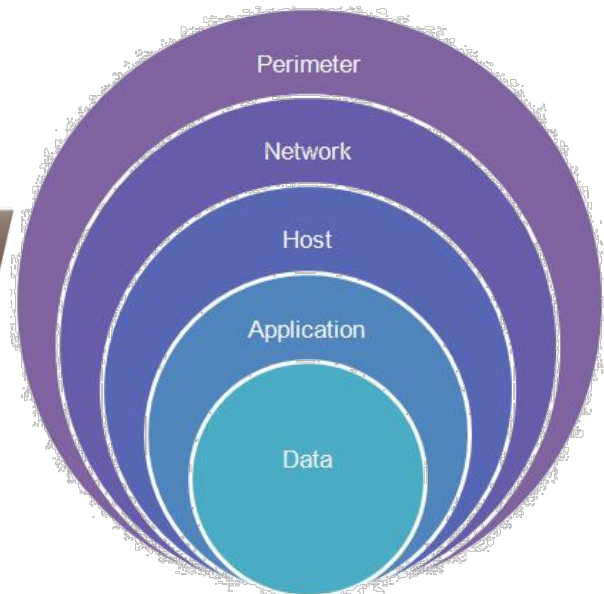
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Security Considerations

- Not exactly a differentiator, but requires attention
- Once you connect to a shared network (or Internet!), security **must** be a priority!
- Defense in depth – defend each layer
 - IT Dept can provide some
 - Protocol security
 - Database / file security
 - Application security
 - Minimum user requirements
 - Secure defaults



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Solution Provider

- Find the best partner
 - Service / support
 - Training
 - Expertise
 - Size (bond a big job)
 - Market specialty (commercial vs healthcare vs data center)
 - Subsystem specialty (also provide lighting controls, fire alarm)



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Architecture

- Core BAS platform
 - Open distribution vs branch / factory support
 - Middleware vs vendor-specific software suite
- Analytics and diagnostics, often in the cloud
- Three models to illustrate range of possible architectures:
 - Single-vendor
 - BAS-centric integrated system
 - Middleware / master system integrator



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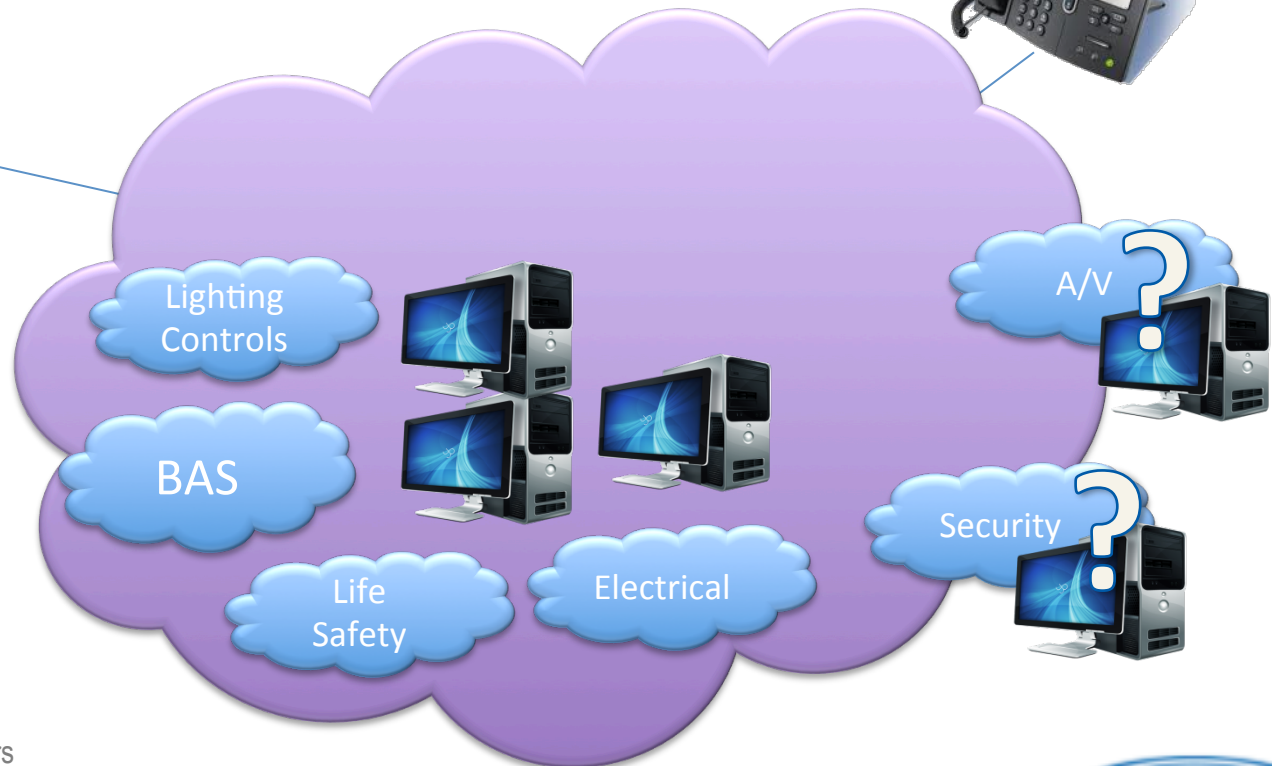
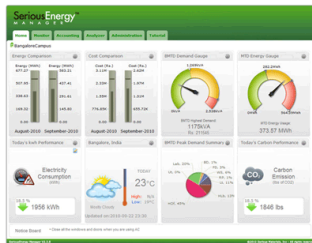
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BAS Architecture Single-Vendor Approach

Dashboard



Level-set > Modern BAS > Differentiators

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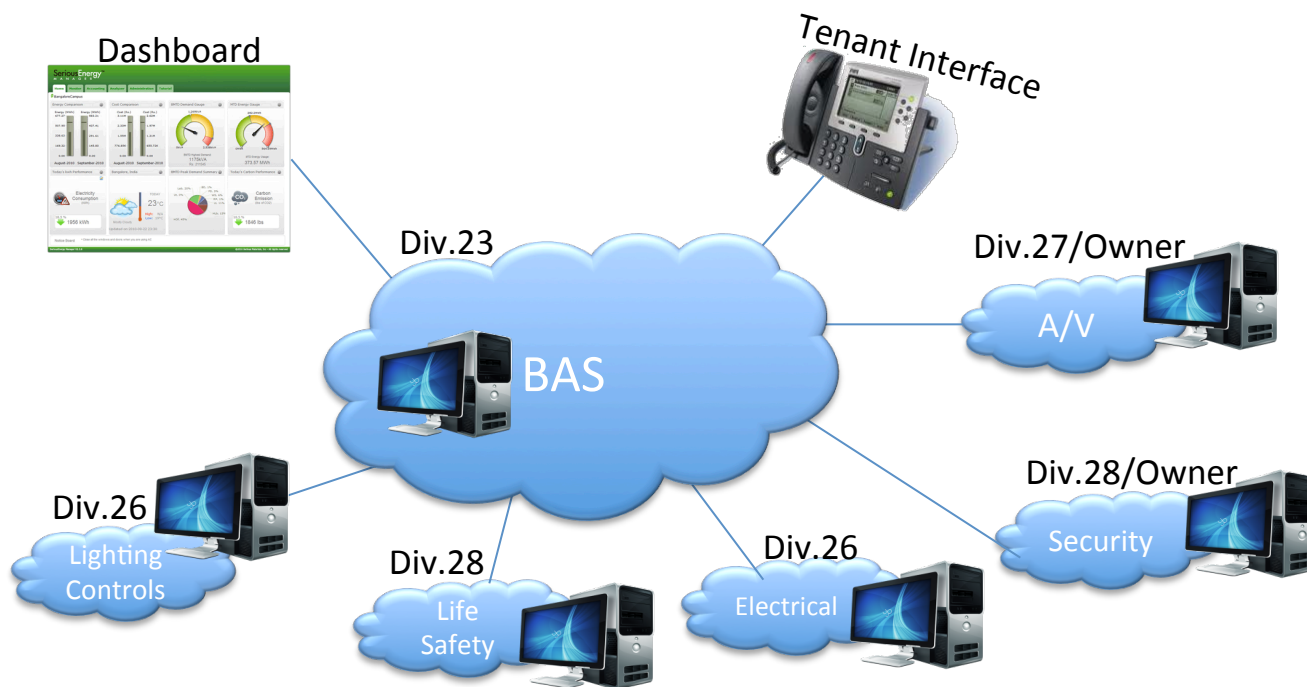
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BAS Architecture BAS-centric Integrated Approach



Level-set > Modern BAS > Differentiators

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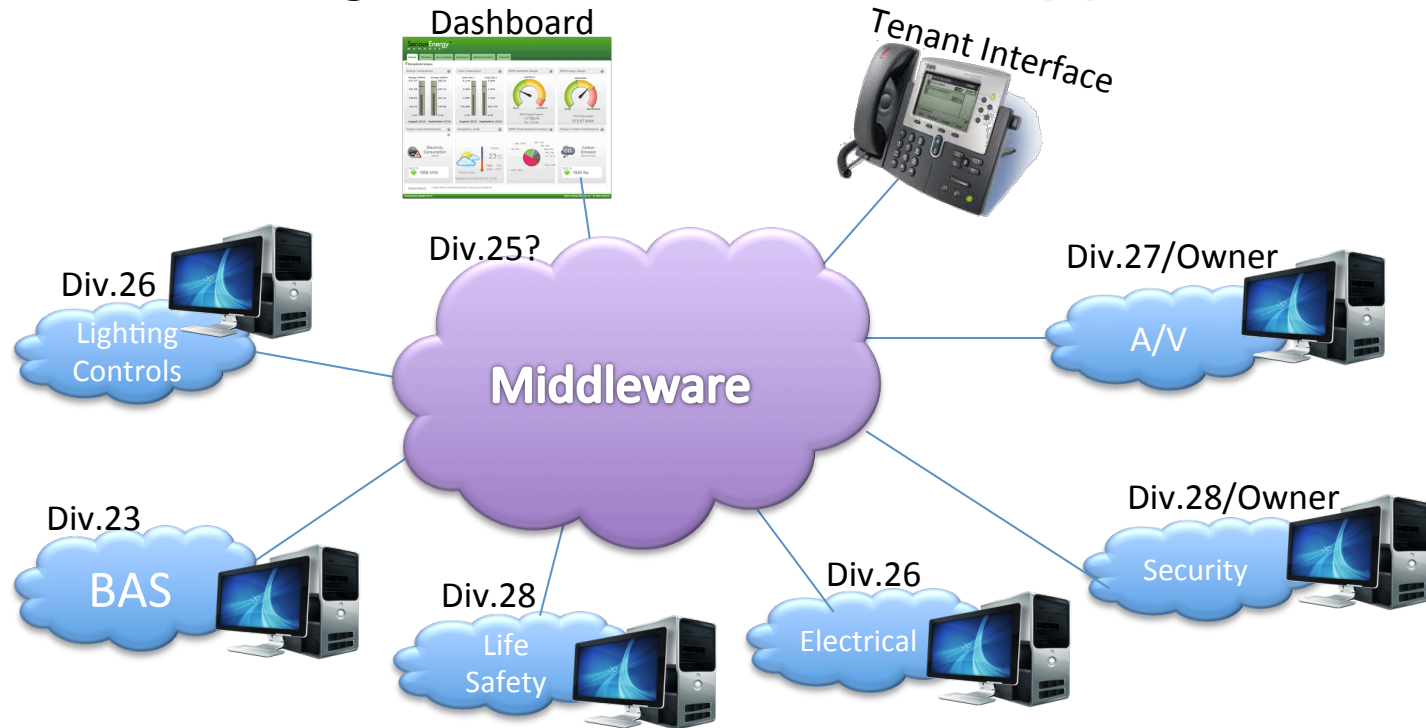


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BAS Architecture Master Integrator / Middleware Approach



Level-set > Modern BAS > Differentiators

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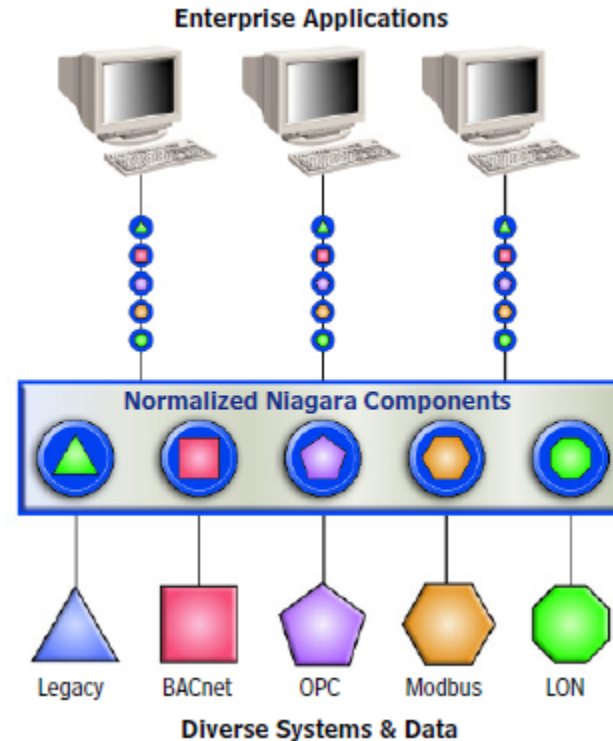
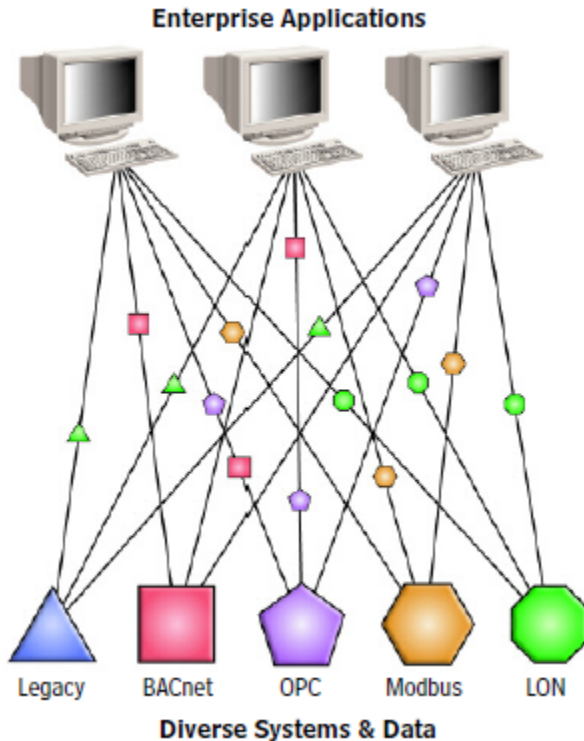
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Middleware?



Level-set > Modern BAS > Differentiators

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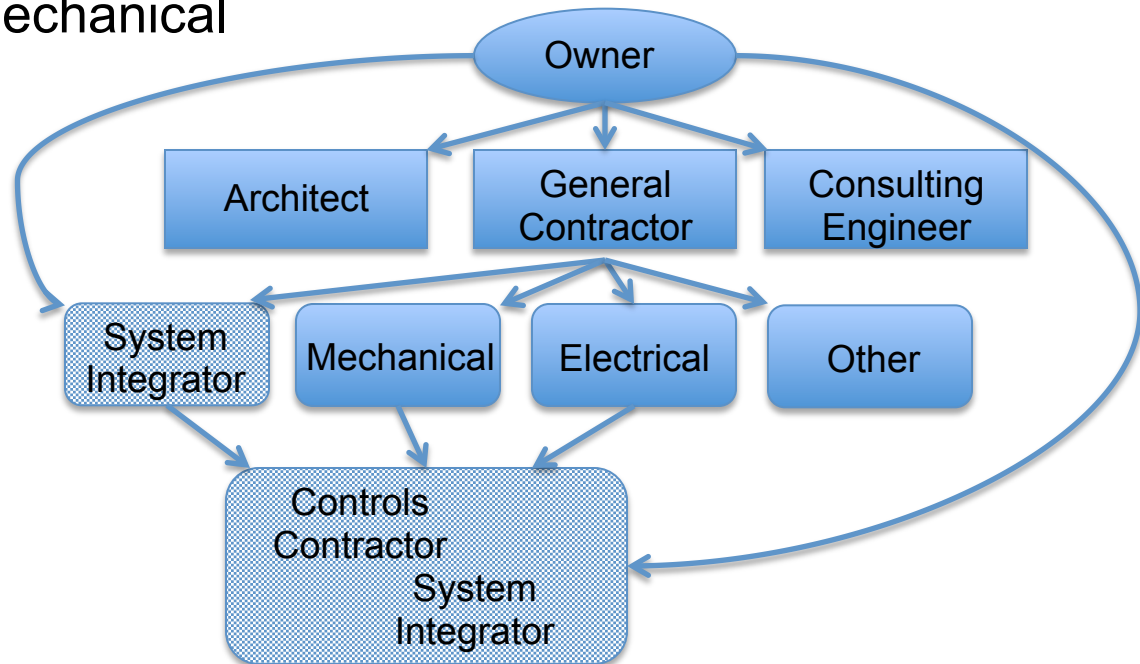
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Contracting Method

- Split spec / system integrator model
- Traditional – sub to mechanical
- Direct to owner



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Packaged vs Built-Up

Packaged Controls

- Not flexible
- Low cost
- Simple-fast
- Manufacturer Pre-defined operation
- Data connection requirements

Built-Up Controls

- Very flexible
- Lead time
- Trade coordination
- User defined operation
- Consistent with system controls

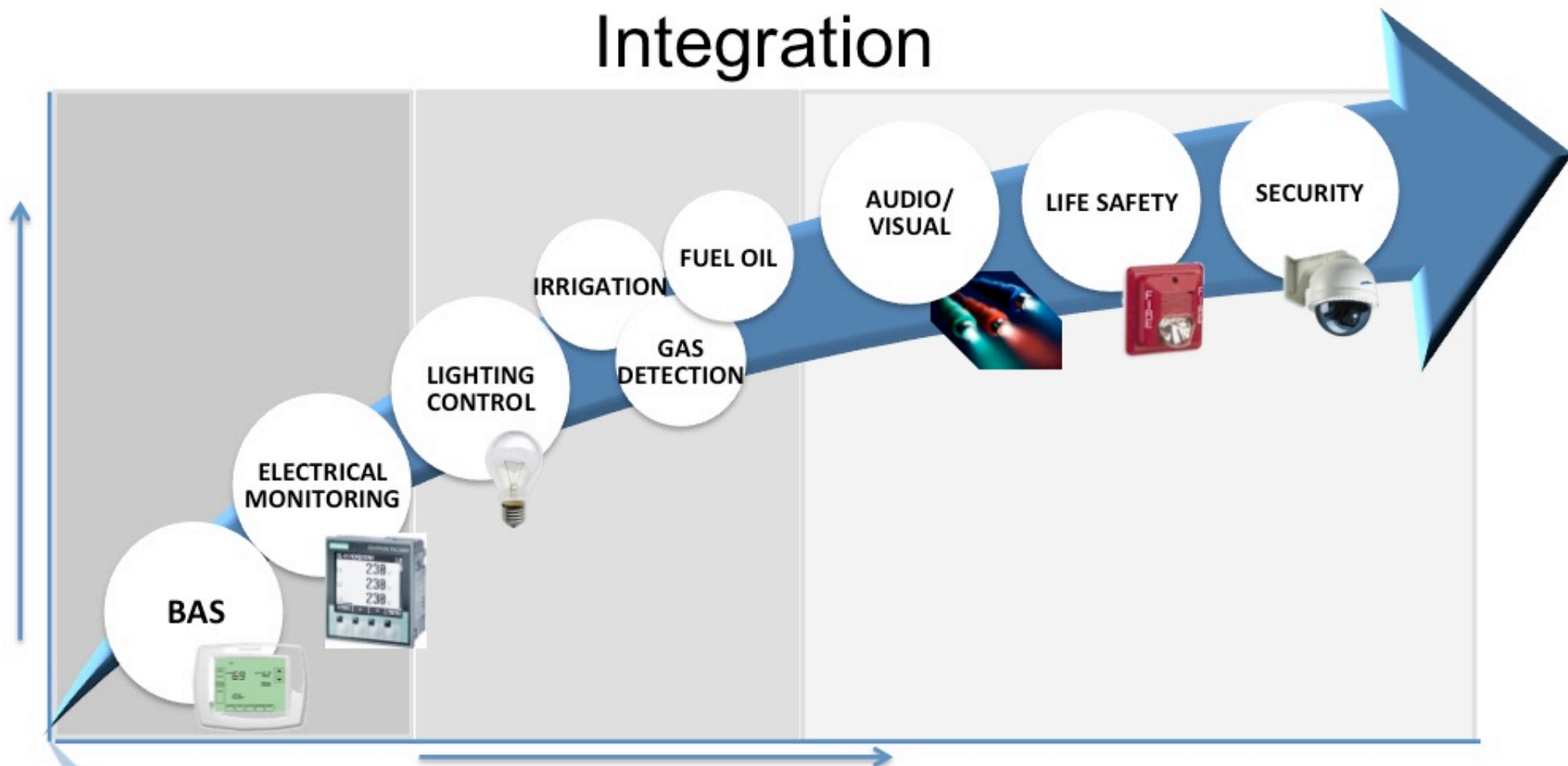
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Integration



Level-set > Modern BAS > Integration

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Integration

- Why are you integrating?
 - Single user interface
 - Legacy systems
 - Interrelated functionality
 - Global strategies
- Why not integrate?
 - Different users / user needs
 - Operational complexity
- Criteria



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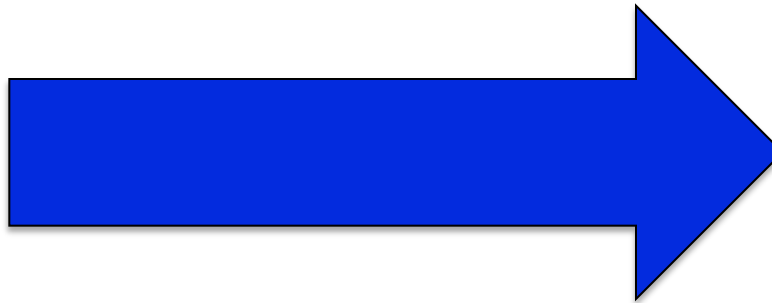
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Intro to Topic

- Level-set / describe “the modern BAS”
- **Simple steps to get started**
 - **You MUST know what you have!**
- Features you *might* be able to add easily



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Simple Steps

- Step 0 – Limitations
- Step 1 – What do you have?
- Step 2 – Does it work?
- Step 3 – How do you operate?
- Step 4 – Improve what you have
- Step 5 – Add/replace with new



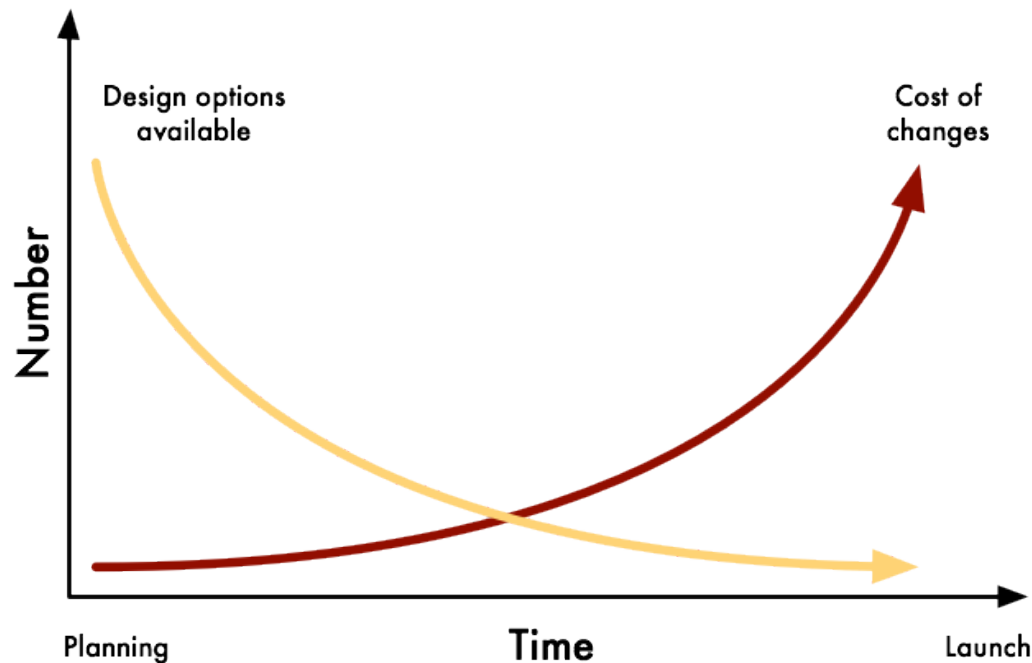
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Does the order matter?



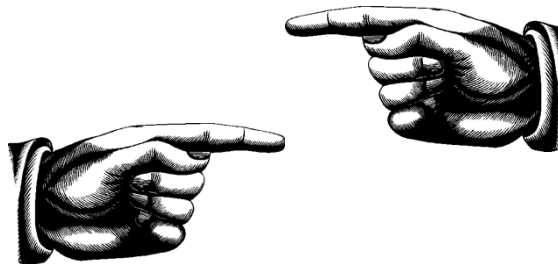
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Step 0 - Limitations

- Controls cannot fix faulty equipment
 - Symptoms of underlying problems
 - Size & space
- Controls cannot fix building construction problems
 - Envelope / orientation
 - Existing equipment and distribution size limitations
- Adequate instrumentation and trending can help reveal the source of inefficiencies



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Step 1 – What Do You Have?

- Survey what you have (or will have)
- Gather info on equipment and systems (proposed or existing?)
 - Existing conditions
 - Legacy controllers
 - System performance
 - BAS control, monitoring only, no interaction
- Documentation!



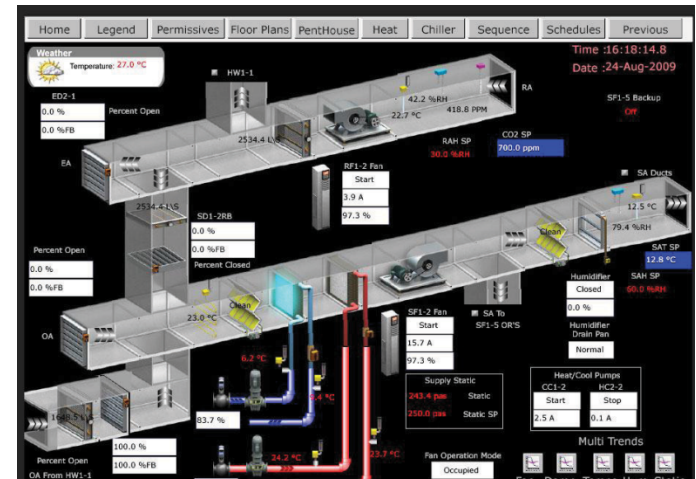
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Step 2 – Does It Work?

- Are needs being met?
 - Reliability
 - Comfort
 - Flexibility
 - Regulatory compliance
- Develop a plan
 - Observe and test performance
 - List deficiencies



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Step 3 – How Do You Operate?

- What are the business requirements?
 - Core functions
 - Short term/long term goals
- Who are stakeholders?
- How do they operate?
- Who needs access?



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Step 4 – Improve What You Have

- Evaluate improvement options based on previous steps
 - Establish a baseline
- Drive for:
 - System consistency
 - Operational efficiencies
 - Ease of maintenance
 - Energy efficiency
 - Flexibility/life-cycle cost
 - Maximize use of system capabilities
- Retro-commissioning/Continuous commissioning



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RCx Defined

- Can be focused on a single system
- Can be performed as part of a renovation
- Can be very detailed
 - Rebalancing each system
- Can be high level
 - May not identify the source of the problem
- Can lead to system re-engineering



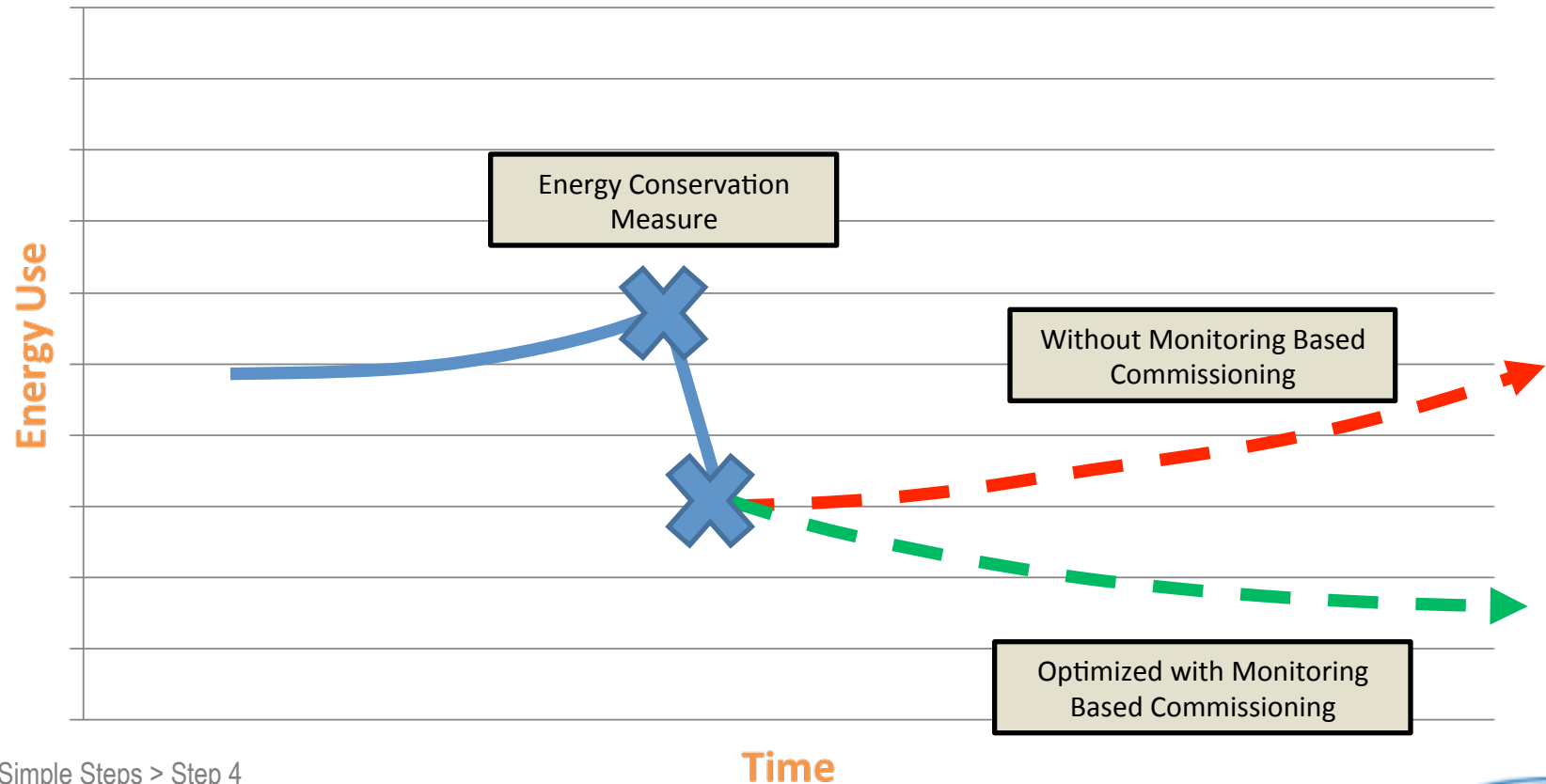
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Why RCx? Why MBCx?



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Why RCx? Why MBCx?

- Focus on resolutions and opportunities
- Building goals and objectives change over time
- Building goals sometimes conflict
- Comfort, extend equipment life, efficient maintenance, energy efficiency
- Even good buildings need tune-ups



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Step 5 – Add / Replace with New

- Evaluate upgrade options before replacement
- Implementation plan – plan, plan, plan
 - Dependencies
 - Schedule
 - Budget
 - Proof of concept
- Add a meter (start getting feedback on how you're doing)
- Add a sensor (expansion capability of existing)
- Address all affected systems

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Good, Cheap, & Fast – Pick Any Two



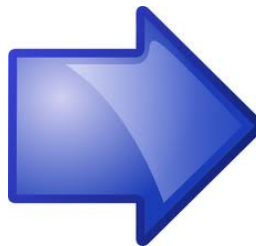
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Intro to Topic

- Level-set / describe “the modern BAS”
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- **Features you *might* be able to add easily**



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Features / Considerations

- Reporting
- Analytics (digging through data manually)
- Diagnostics (getting alert automatically)
- Aesthetic concerns – sensor appearance
- Interface (thick client or web based)
- Other interface uses – kiosk, dashboard, phone/tablet
- Smart navigation (shows you the problems – manage by exception)
- Programming language / environment
- Ability to interface with IT systems (CMMS / asset management / CRM)
- Reliability / fault tolerance



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For Best Results....

- Have a clear business goal
- Talk to all stakeholders
- Formulate a rough plan
- Talk to vendors - get their feedback
- There are many variations, so ask!
 - Built into BAS vs. 3rd party application
 - Owned vs SAAS / Cloud
 - Degree of customization
- Be judicious – if you really want the nav, you'll probably need to pay for leather seats and satellite radio!



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Reporting

- Support business needs
 - Regulatory / compliance
 - Energy / ECM
 - Production
 - To the C-suite
 - Tenant billing
- DIY (Crystal Reports)?
- Could give report consumer the ability to self-serve



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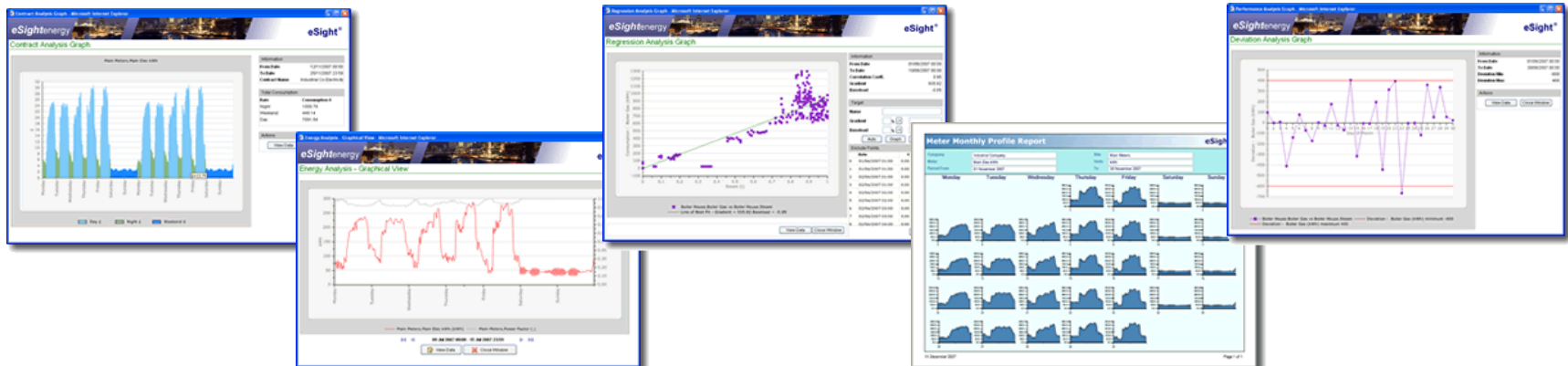
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Analytics

- Start using the data to troubleshoot and optimize
 - Energy analytics software + historical data = power
 - Verify bills
 - Compare against baselines, normalize for weather
 - Hone system performance



Features > Analytics

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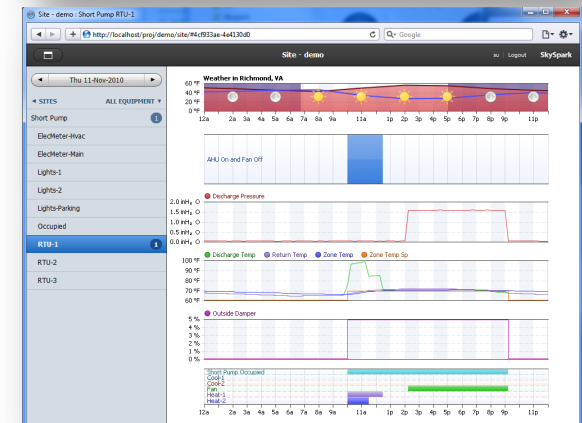
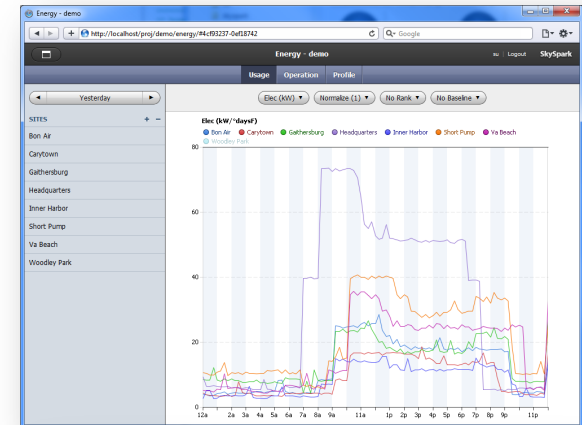


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Diagnostics

- Get alerts automatically
- Start “managing by exception” instead of looking around for problems
- Write rules to define complex problems
- The equipment can tell you when it’s broken
- Sometimes a.k.a. optimization / commissioning
- Sometimes optimization is a separate topic....



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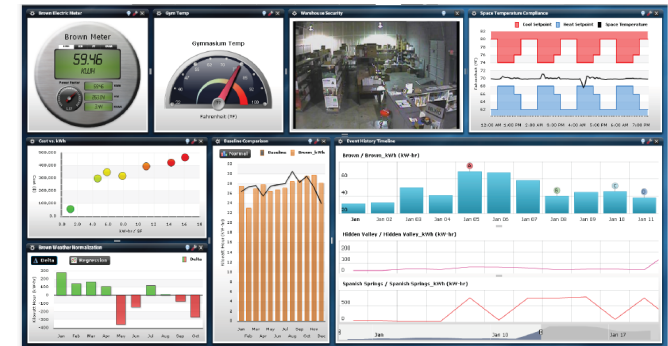
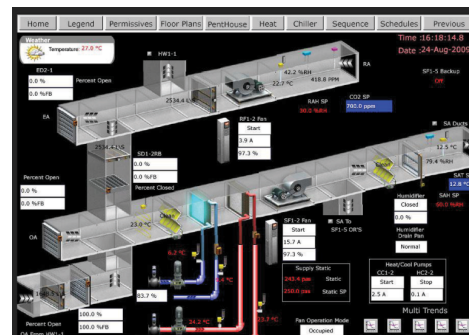
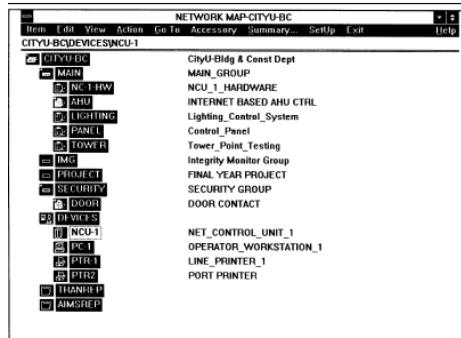


Aesthetics

- Aesthetic concerns
 - Sensor appearance
 - Graphics appearance



Figure 6 Network configuration list on METASYS showing internet-based AHU control

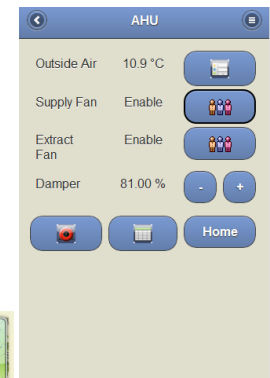


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Interface

- Thick client or web based?
- Intended for experts, novices, both?
- Support for mobile / tablets?
- Dashboards (kiosk vs management)?
- Other devices (IP Phone)?
- Subsystems: one or multiple?



Features > Interface

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Smart Navigation

- Shows you the problems – manage by exception
- Follow normal workflow
 - Floor 3 -> VAV -> AHU -> Chiller
 - Equipment -> as-built drawings, O&M manuals
- Building information model interaction?
- This could be a product offering, or a customized attention to detail by the integrator



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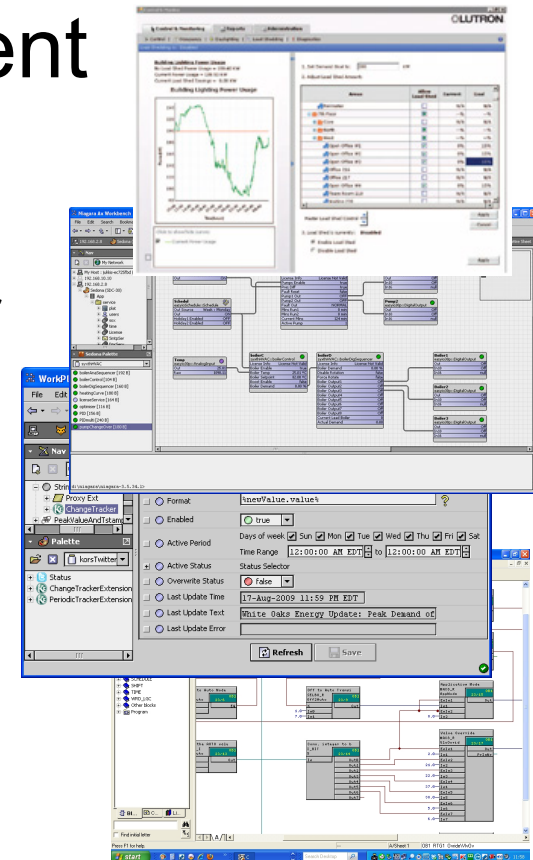
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Programming Environment

- Do you care? If you won't be using it....
- Single tool for everything?
 - Program and download a sequence to a controller (each type)
 - Add / modify a graphic
 - Add / modify global strategies
 - Trends / alarms / schedules
- What about all the other subsystems? Lighting, metering, etc.
- Backwards compatible?



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Interface with IT Systems / 3rd Party

- Network
 - Leverage their network? VLAN, VPN, IPSEC....
 - Are your protocols OK?
- Data Center
 - Care and feeding of your servers
- Applications
 - Data center: IT Department's network manager / DCIM
 - Maintenance management / work orders
 - Asset management / IWMS
 - CRM, SCADA, custom reporting, and more...
 - XML / SOAP / Web Services / open API

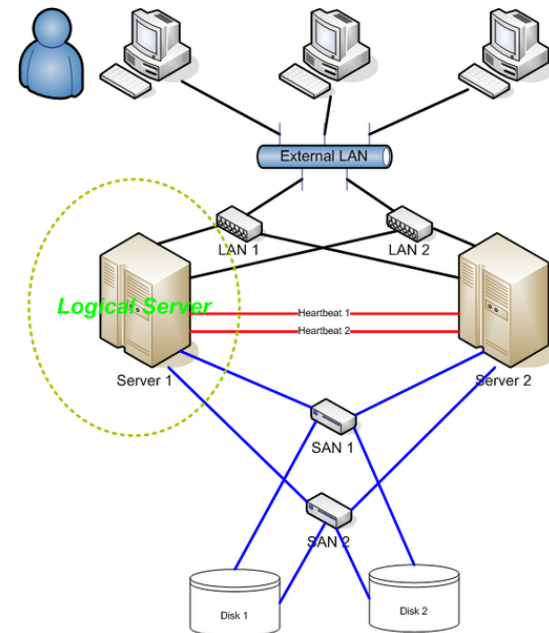


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Feature – Fault Tolerance

- Dual redundant hot-swappable:
 - Network / pathways
 - Power supplies
 - Servers
 - Controllers / processors
 - I/O modules
- Power quality
 - Normal, generator, or UPS
 - Added conditioners and UPS modules
 - Don't forget power to the network
- Layout / design considerations – good Distributed Control is key!



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Strategies.... What Could you be Doing?

- Integrate to other systems
 - Share sensors
 - Share a single user interface
- Integrate to other software (CMMS)
- Improve energy performance
- Trying to manage by exception
- Spend your time RCx instead of chasing fires – proactive not reactive
- Consolidate documentation / manuals / drawings
- Facility asset model (BIM)
- Only buy open protocols (in industries where this is available)



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Conclusion

- What to expect from a modern BAS
- Strategies / process for improving your facility operations
 - Understanding what you have & keeping it running is half the battle!
- Highlight a range of available features

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