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Sustainability Through Intelligent Controls Workshop

ICEBO 2012 – Manchester, UK

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Total Facility Control

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Mr. Bernstein is President of RBCG, LLC providing consulting services to organizations needing help navigating their energy and automation strategy. He has over 30 years experience in industrial, commercial and residential automation and controls technologies. RBCG provides building automation standards, specification development support, educational program development, and facility master planning.

Key areas of focus include energy management and open solutions for energy efficient control networking. He helps organizations evaluate and implement technologies and solutions based upon open interoperable system architectures. He is an active member of several standards bodies including ASHRAE, ANSI/CEA, CEN, LonMark, OASIS and ISO.

Mr. Bernstein holds the position of LonMark International Chief Ambassador, is a Director of the Smart Buildings Institute, curriculum advisor to Mt. San Antonio College, frequent lecturer, published author, and educator.

He holds a BS in Mechanical Engineering from Carnegie Mellon University, a Masters in Psychology from The University of Santa Monica, and a Masters in Philosophy from PTS College of Philosophy

RB CG RON BERNSTEIN CONSULTING GROUP, LLC

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Workshop Agenda

- Introduction, Energy Efficiency Through Intelligent Controls
- The Trend Towards Open, Integrated Control Systems
- Elements of an Open Controls Platform
- Enterprise Applications, Cloud Computing, and System Security
- Specification Development Requirements
- Introducing the Three-Tier Building Automation System Spec
- Energy and Cost Savings - Use Case Examples
- Tools, Resources and Standards

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Energy Efficiency Through Intelligent Controls

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Green Building - Sustainable Design

- Green building is the practice of increasing the efficiency with which buildings and their sites use and harvest energy, water, and materials, and reducing building impacts on human health and the environment, through better site selection, design, construction, operation, maintenance, and removal
  — the complete building life cycle.

- Green sustainable building benefits:
  - Reduced operating costs
  - Increasing productivity
  - Using less energy and water
  - Improved public and occupant health
  - Improved indoor air quality

Source: Wikipedia

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Energy Consumption Data

- Buildings represent **70%** of U.S energy consumption
- Energy consumption represents **30%** of a typical commercial office building's operating costs
- A **30% reduction** in energy use can yield the equivalent of a 5% increase in Net Operating Income
- One of the strongest selling points for green construction is reduced operating costs from increased energy efficiency

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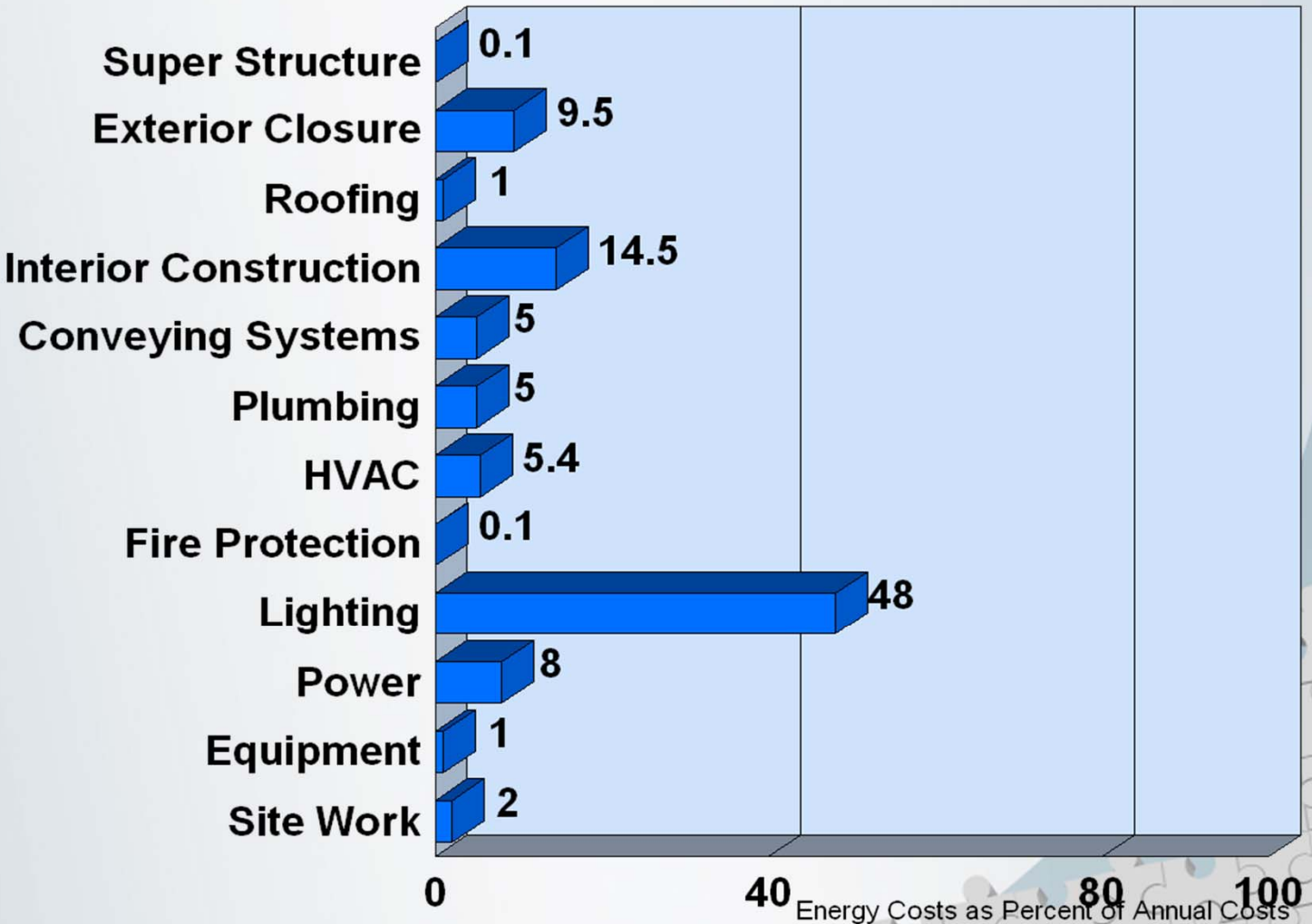
Typical Building Energy Costs



Source: U.S. Department of Energy

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Energy Savings By Type of Technology Applied

Control Technology	Energy Savings	Payback Period
Energy Management and Control System	5 to 15%	8 to 10 years
Commissioning	5 to 15%	2 to 10 years
Continuous Commissioning	5 to 15%	1 to 3 years
Occupancy sensors for lighting control	20 to 28%	1 to 5 years
Photo sensor based lighting control	20 to 60%	1 to 7 years
Demand Controlled Ventilation	10 to 15%	2 to 3 years

Source: U.S. Department of Energy

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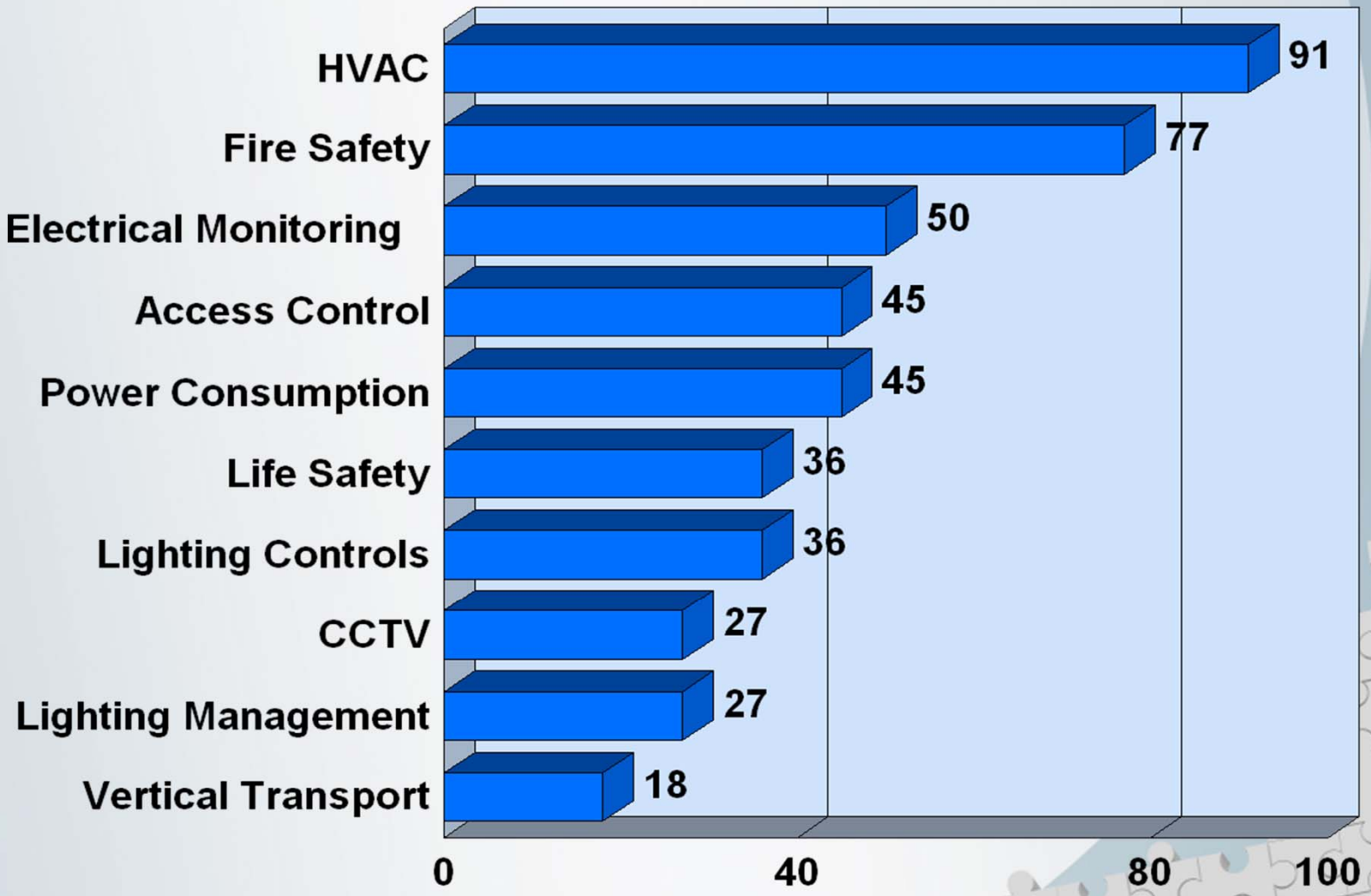
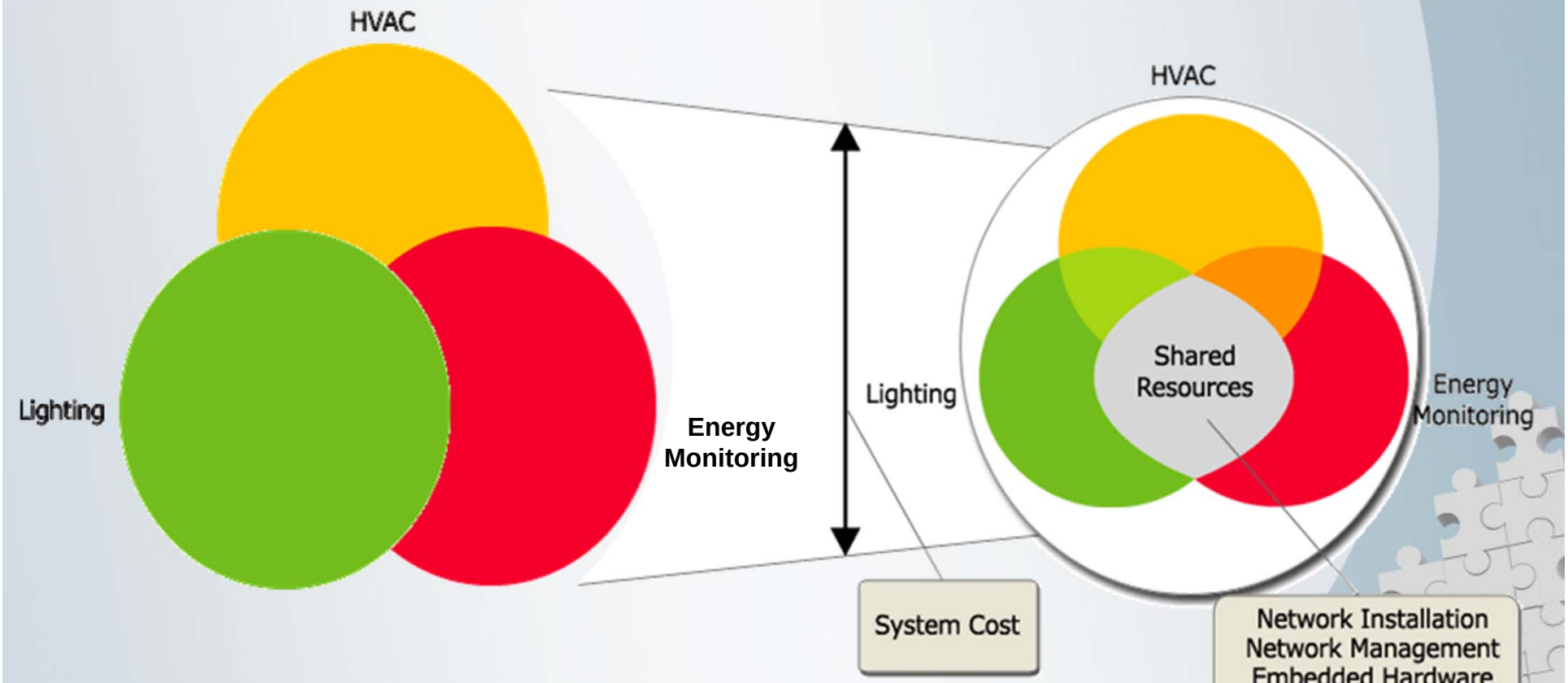
Most Likely Systems To Integrate



Source: U.S. Department of Energy

Leveraging Costs of Multiple Integrated Building Systems



Openness facilitates Integration !

Source: TAC.

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System Integration Life Cycle Cost Analysis

Life Cycle Cost Component	Non-Integrated Building	Partial Integration	Full Integration
Comparitive First Cost	$75,000	$78,000	$33,000
Changes, Upgrades & Additions	$129,379	$126,379	$88,052
Operating & Maintenance	$21,250	$5,250	$3,750
Utility Cost	$200,000	$179,400	$179,400
Net Present Value	$2,325,232	$2,074,091	***$1,773,493***
Discount Rate	9%		
Life Cycle Period (yrs)	10		
—▶Savings		**($300,598)**	**($551,739)**

Source: CABA

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The Trend Towards Open, Integrated Control Systems

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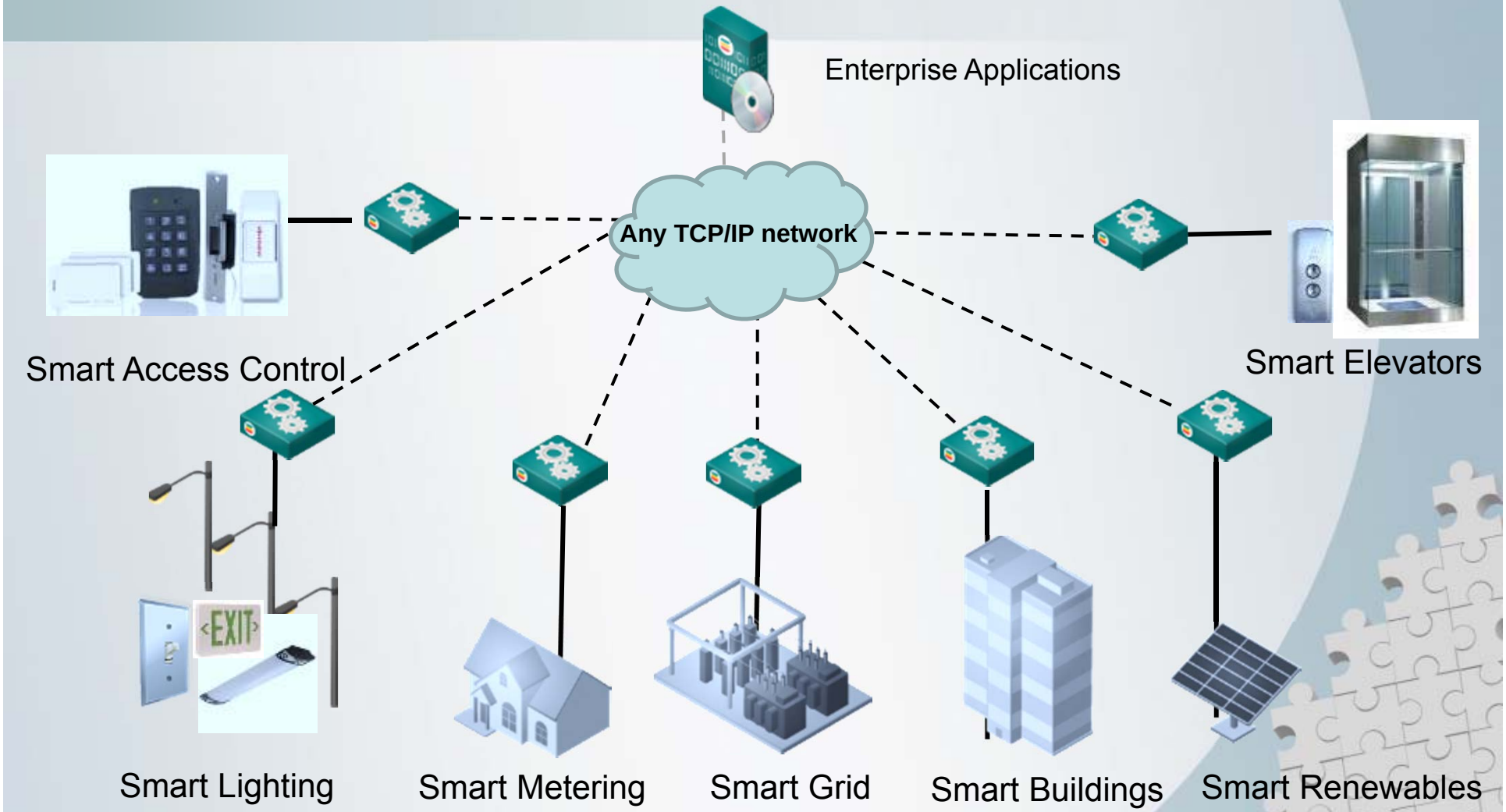
Open Systems Defined

- Open building systems are created using the products and systems from multiple vendors that in the end offer greater flexibility, easier management, higher levels of scalability, and lower life cycle costs.
- Fully Open Systems Will Deliver
  - **Greater choices in vendors and suppliers**
  - **Lower energy costs**
  - **Lower install and life cycle costs**
  - **Easier add, moves, and changes**
  - **Greater system scalability**
  - **Better access to information**
  - **Greater control over the facility**

Multi-Subsystem Integration



Solutions That Meet the Need

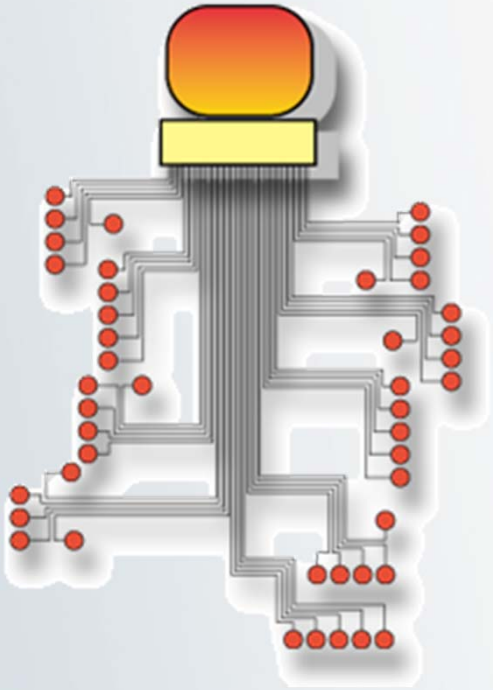
- Give Me Access
  - From any location
    - Phone
    - Email
    - Home
    - Office
- Make It Easy
  - Decision making
  - Alarming
  - Reporting

Building Automation Market Trends

- Industry preference for open systems
- Expectation for better energy efficiency
- Demanding lower operating expenses
- Growing requirement for integration
- Enterprise access via web – leverage growing IT infrastructures
- Do more for less

Data-Bus Technologies

1st Generation
Centralized Architecture



- Top-down design
- Centrally located processor
- No integrated intelligence
- Single point of failure
- Maintenance restricted to provider of processor station

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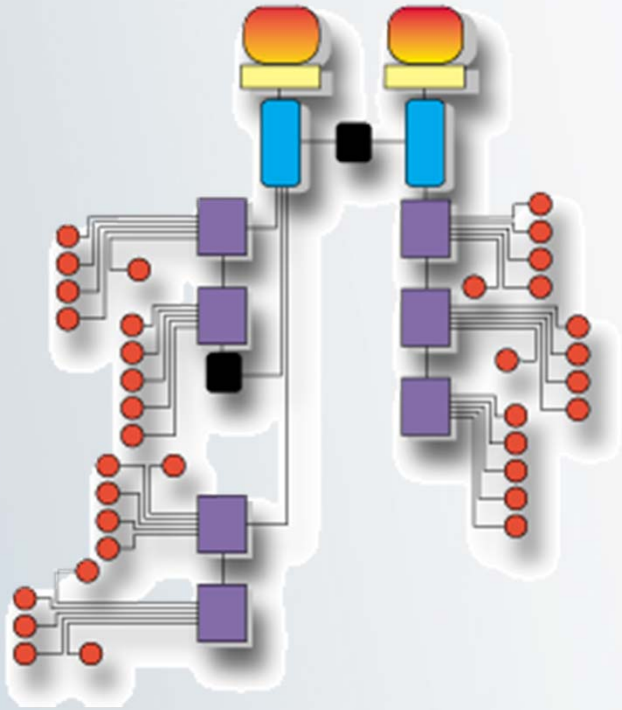
Data-Bus Technologies

2nd Generation
Networked PLCs



- **Programmable Logic Controller design**
- **Centrally located processors**
- **Distributed intelligence**
- **Single point of failure reduced**
- **Maintenance restricted to provider of PLCs**

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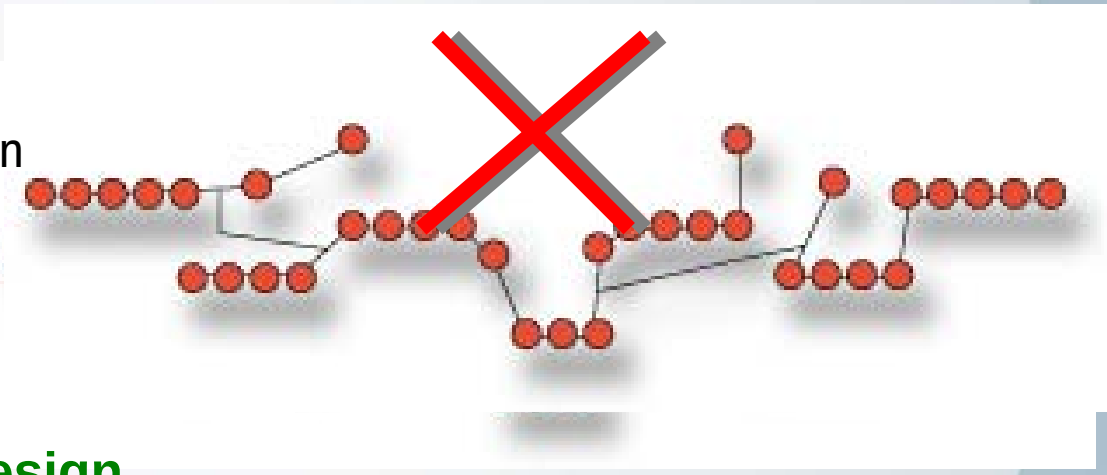
Data-Bus Technologies

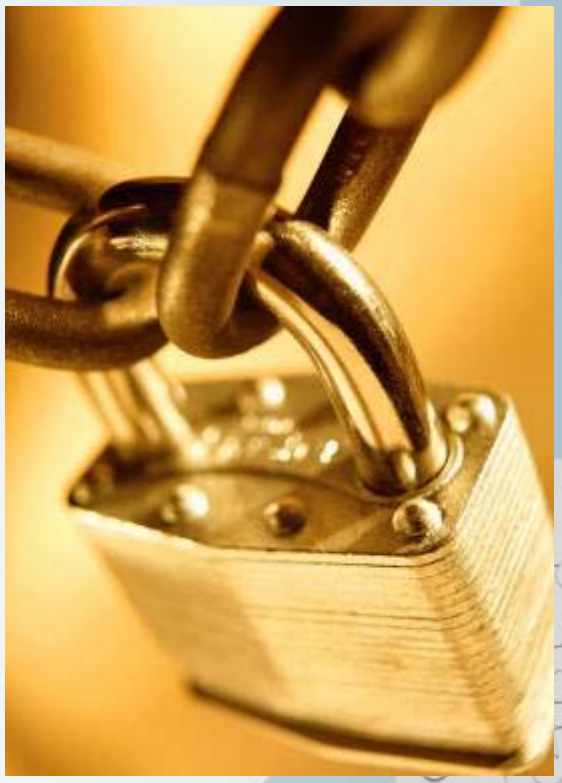
3rd Generation
Decentralized Automation



- **Intelligent-devices design**
- **No central processor needed**
- **Fully distributed intelligence**
- **Single point of failure eliminated**
- **Maintenance not restricted to providers of hardware**

Traditional Closed System

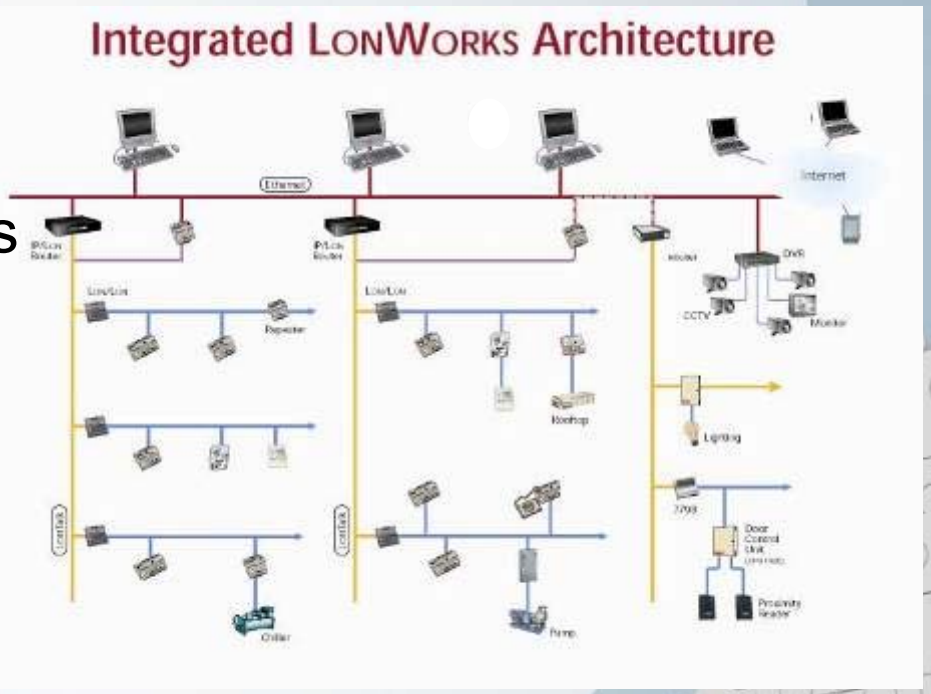
- Single vendor
- Leads to costly service and system expansion
- Limits sub-system expansion
- Limits number of service providers
- Restricts interoperability with other vendors / systems
- Limits choices
- Creates “Islands of automation”



➢**Locks owners in for the life of the system !**

Open System, Not Just and Open Protocol

- Multiple vendors
- Affordable and economical service and system expansion
- Sub-system and device-level expansion at any time
- Full choice of service providers
- Facilitate interoperability with other vendors / systems
- Plethora of choices
- Flexible, expandable automation



➢Owners retain freedom of choice throughout the lifetime of the system !

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Focus on End User Requirements

- Choice of vendors – “Best of breed” products
  - Not locked into single supplier
- Easy integration
  - Quicker, lower cost installation
- Use of third party tools
  - Eliminates need for multiple or proprietary tools
- Easier adds, moves, and changes
  - Reduces life cycle costs
- Greater level of integration between sub-systems
  - HVAC, Lighting, Energy Management, Security, Irrigation, etc.

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Open Versus Closed

Open	Closed
Published industry standard	Single company promoted
Adopted by major industry suppliers	Adopted by only a few or single supplier
Multiple vendors products work on single system	Only one/limited vendors product works on system
No engineering effort needed to “make them talk”	Complex engineering effort required to “make them talk”
Multiple integrators can work on same job	Only one integrator can work on job
More than one GUI type on system	Only one GUI type usable on system
Multiple sources of competitive, interoperable product	Limited or sole source of product
Service of system from multiple sources	Service of system by single source
Network management tools available for installation from multiple sources	One or limited tools available. Can only work with one suppliers devices.
Flat architecture	Tiered architecture
Expandable with transparent Routers	Limited expandability, no routing
No Gateways or gateway to legacy system only	Extensive use of gateways, new or legacy system
Empowers independent integrators	Empowers single company solution

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Workshop Discussion Question #1

What issues do facility owners, end users, managers, system integrators face today?

Total Facility Control

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Results from Prior Workshops

1. Save energy, quantify energy usage, define ROI for energy reduction
2. Capture and present information (power, water, CO2, temp, humidity, etc)
3. Access to information [Data Stratification]
4. Integration of systems
5. Open vs. Proprietary platform
6. Competition, fair competitive bid
7. Life cycle costs of buildings
8. Value of automation
9. Security, data and system integrity
10. Technology selection, partner selection, product selection
11. How to sell the value to the client
12. Operation and maintenance costs
13. Training (technology, technical)
14. Legacy system integration and migration
15. Need for better education (market, options)
16. Government incentives
17. Energy evaluation and assessment
18. Open protocols
19. Specifications

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The Elements of an Open Controls Platform

Elements of an Open Control Networking Platform

- Networking Protocol for Device Level Communication
- Low Cost
  - Solutions on a chip (multiple solutions/sources available)
- Peer-to-Peer
  - No master needed – no vendor lock in
- Interoperable
  - Devices from hundreds of suppliers work together
- Open – ISO Standard
  - Open Interoperable standards for control communication
  - Certify devices for standards compliance
  - Certify industry professionals for technical proficiency
  - Certify System Integrators – provide high level of competence
  - Simplify specifications, installation, and integration

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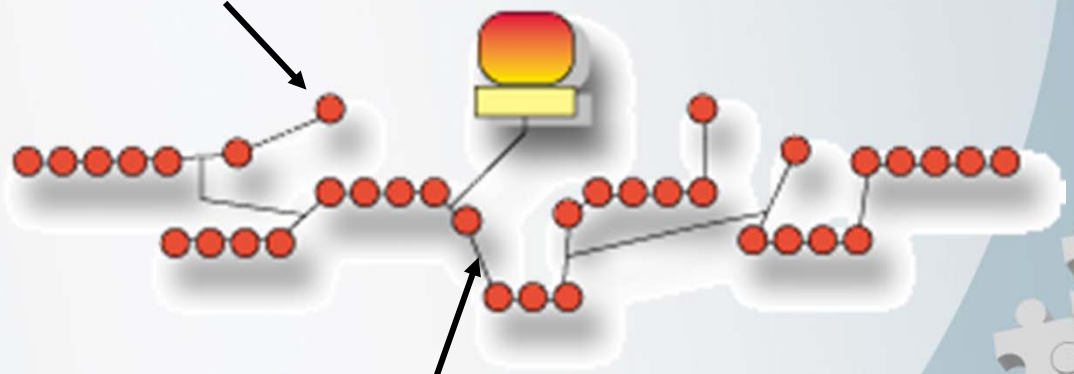
Primary System Elements

Device

Network Tool



Channel

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Essential Elements of an Open Control System

- **Devices**
  - The controllers on the network
  - Applications specific devices
  - Programmable devices
  - Packaged equipment
  - Scheduling, Alarming, Data logging
- **Infrastructure**
  - The wire the nodes connect to
  - The routers that pass the data
  - Termination
  - Traffic issues
  - Systems architecture
  - IT Routing
  - When are gateways necessary?
- **Host Interface**
  - PC Based
  - Cloud/Web Based
  - Flexibility and Choices
  - Secure, IT Compliant
- **Tools**
  - Design Tools
  - Commissioning Tools
  - Database issues
  - Plugins
  - Scheduling, Alarming, Data logging
- **Enterprise Connectivity**
  - IT Interface
  - Large project architecture
  - Design for the future
  - Scalability issues
- **Life Cycle**
  - Long term service contract
  - Staff training
  - Sustainable design

Don’t get locked in!

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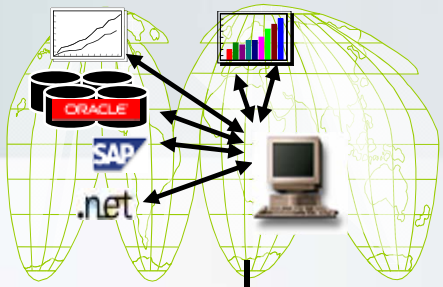
Enterprise Applications
Building Operations Center
Cal/Dispatch Center
Reporting/Scheduling
EASI Interface



Remote Access
Email Alarms
Browser Based Monitoring
and Control

WAN

Internet/VPN/Frame Relay

Graphical User Interface
Network Tools
Diagnostics
Web Interface

Firewall

Gateway to proprietary systems

LAN

IP-852 Router or
oBIX XML Server or
Web Server or
EASI Interface

IP/Ethernet

LON

Device Network

Standard Network Variables
Exchanged Between Devices
and to PC, Web, Remote Access

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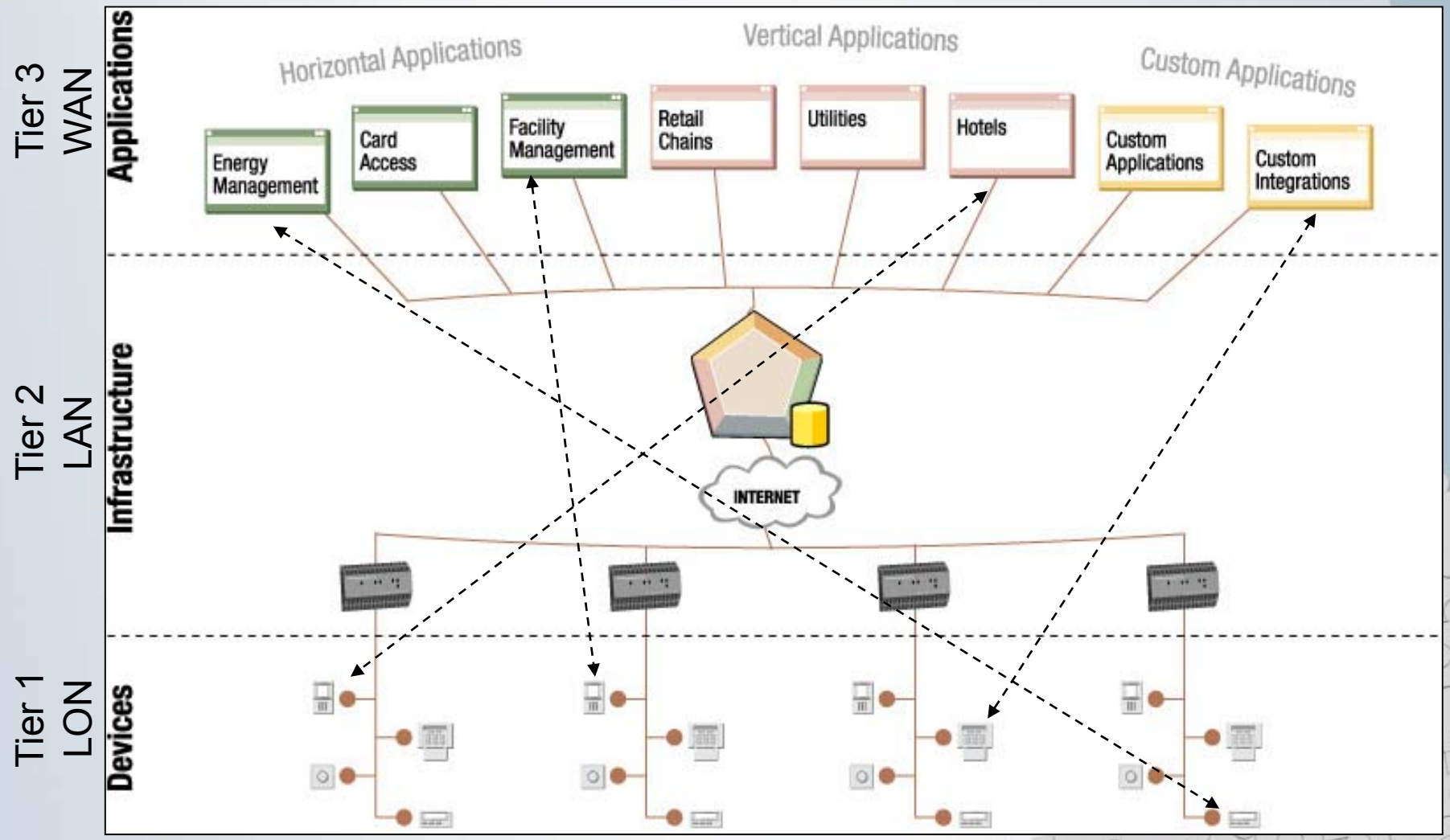
Total Facility Control
The Need for Higher Level Connectivity



Foundation of an Open System

- Products from multiple vendors interoperate
  - Common physical interface - transceiver
- Tools from multiple vendors interoperate
  - Common network management model - LNS
- Opens up for fair competitive bidding
  - Unbundling hardware from software from engineering
- Enables owners to “own” their systems
- Removes the “Locks”
- Open specs: Reduces costs, improves efficiency
- International standard – worldwide adoption

Integration At the Building Level Means Access To Information

Service Provider
Application Interfaces

Remote Monitoring
and Control

FIRE
Functionality checks
Detector service
Valve Pressure
Fire, Life, Safety

SECURITY
Doors
PIR
Integration

ACCESS
Doors
Buildings
Occupancy
Feed Forward

ENERGY
Appliances
Electronics
Utility Monitoring
(Elec/Water/Gas/Oil)
Load Shedding
Air/Water
Heat
Lighting
Solar Generation

LIGHTING
Indoor/Outdoor: Schedules
Occupancy Sensing

Appliances
Breakdown
Maintenance
Performance

Home Electronics
Audio
Video
Computers

24/7 Monitoring
Service/Maintenance
Demand Response
Conditioned Monitoring
Vehicle Charging

HVAC
Air-Handling Unit
Boilers
Pumps
Fans
Energy Control
Hot Water Heaters
Air Quality

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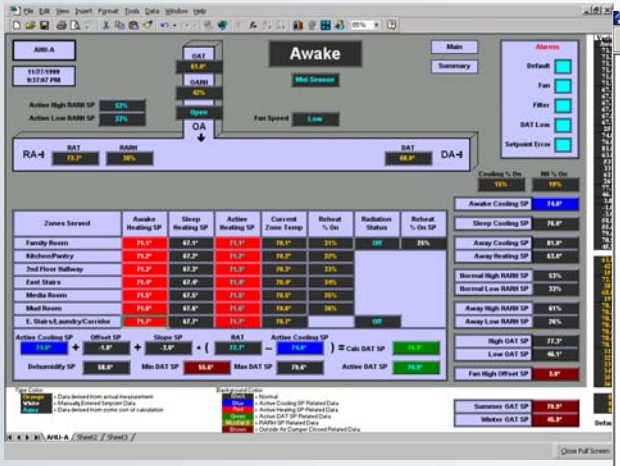
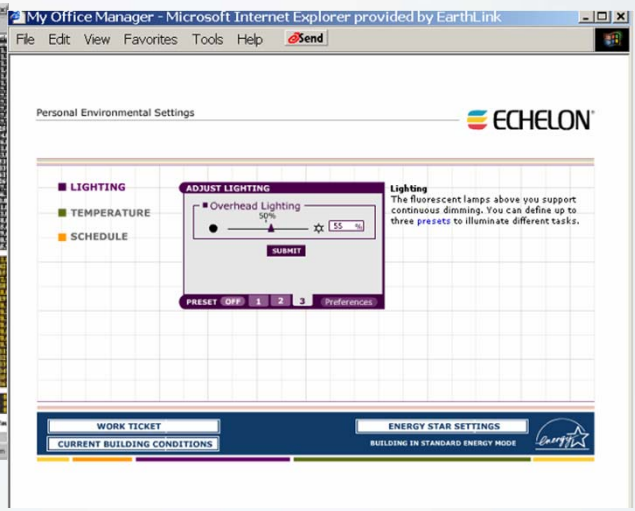
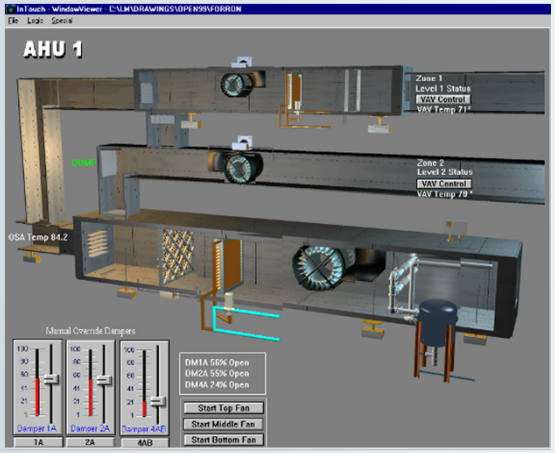
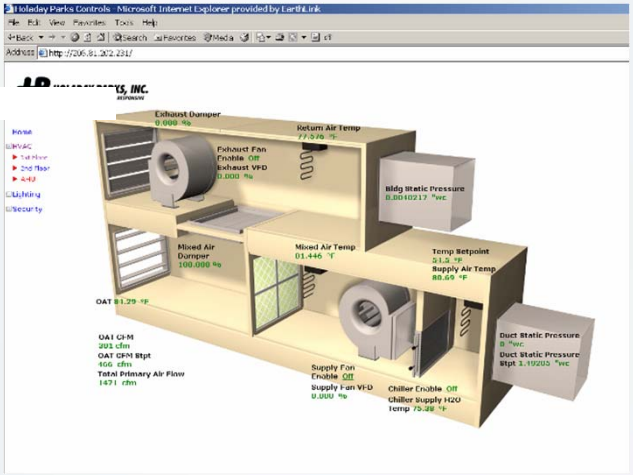
Information Access – The Key









- Alarming
- Control
- Monitoring
- Setpoint changes
- Overrides
- Schedule changes
- Maintenance schedule
- Event reporting
- Quality control
- Energy Management
- Enterprise-wide consistency

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Information Access – The Key

- And I want it from my browser
- From any computer on my network
- Or from home
- With different access levels for different personnel needs
- With my full campus integrated into one system
- And all of my subsystems working together
- To simplify my facility management
- And reduce my operating costs!

- Alarming
- Control
- Monitoring
- Setpoint changes
- Overrides
- Schedule changes
- Maintenance schedule
- Event reporting
- Quality control
- Energy Management
- Enterprise wide consistency

Which Means…

- I need a fully integrated system
- With a solution platform that will grow over time
- That isn't limited today or in the near future
- That uses the latest advancement in technology
- But is proven to work – I don't want to be the guinea pig
- And it will reduce my install and life cycle costs
- Simplifying my management operation
- And provides a positive return on my investment

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Total Facility Control Access to Data

Layer	Stakeholder	Data level	Data Types Examples
Enterprise	Owner/Master integrator/Facility Staff/Application Developer/Aggregator	5, 6 - Aggregate, Monitor, Report	Energy savings, pricing, reporting/monitoring, scheduling
Campus/ District	Owner/Master integrator/Facility Staff/Application Developer/Aggregator	4, 5 - Schedule, Report, Monitor	Alarms, Monitoring, Scheduling, Energy Data,
Premises/ System	Owner/Integrator/Facility Staff/Application Developer	3, 4 - DR, Load shed, control, monitor, schedule	Energy mode, ADR Signals, Alarming, Scheduling
Zone	User/Occupant/ Manufacturer/Vendors/ Integrators	2, 3 - Status/Mode/Scene, schedule	Occupied mode, Load Shed mode, Lighting scene
Room	User/Occupant/ Manufacturer/Vendors/ Integrators	2 – Status Mode Scene	Occupied mode, Load Shed mode, Lighting scene
Device	Manufacturer/Vendors Integrators	1 - on/off/control, low level data	Temp, pressure, status, set points, mode, scene

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Total Facility Control
The Players

Stakeholders	Level
Developers Manufacturers	Core technology, Transceivers, Protocol, Security, Applications
Vendor/Supplier/ Distributor	Interoperability, Sourcing, Costs, Codes, Availability, Features
Consulting Engineers	Specifications, System Architecture, Functionality
System Integrator	Bids, Specs, Submittals, Tools, Integration Support
Master Integrator	IT, Interoperability, System Level Functionality, Openness, Front Ends
Facility Manager	Front End, Functionality, Training, Operational Efficiency
Owner	Energy Savings, Operational Savings, Down Time, Costs (short and long term)
Aggregator	Access to Building Data, Interoperability, Simplicity, Costs
Service Provider	Applications, Access to Data, Interoperability
Application Provider	IT Integration, Standard Interfacing, System Integration, User Interface, Platform

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Open, Integrated Controls

- Competitive advantage over proprietary, closed systems
- Perfect solution for campuses, multi-building, integrated buildings
- Provides for competition at every stage of the project (Owners demands are met!)
- Wide array of available solutions
- Enables “Enterprise Connectivity, Enterprise Independence”
  - From sole source products
  - From locked-in bundled hardware/software solution
- Three-Tier Specifications give owners more control
- Based on open industry standards

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Workshop Discussion Question #2

What are the Wants, Needs, and Desires of facility managers?

Total Facility Control

Results of Prior Workshops

- Cost savings
- Competitive bid
- System ownership
- Future proof / flexibility
- Choice
- Vendor independence

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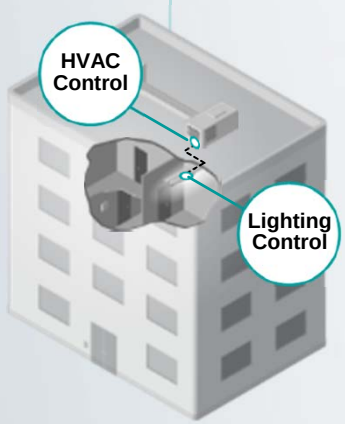
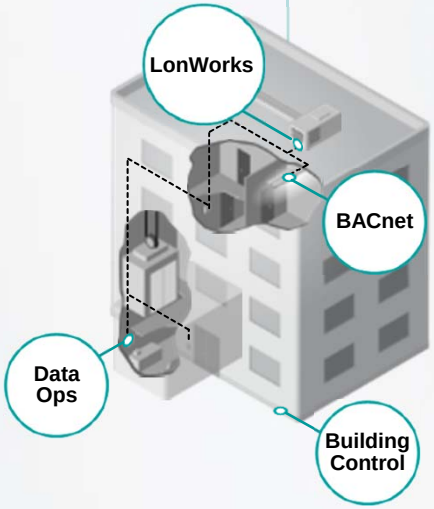
Smart Building → Grid-Aware Building

Individual Control → **Smart Building** → **Grid-Aware Building**





- Stove-piped functions (silos)
- Multiple front-ends
- Proprietary

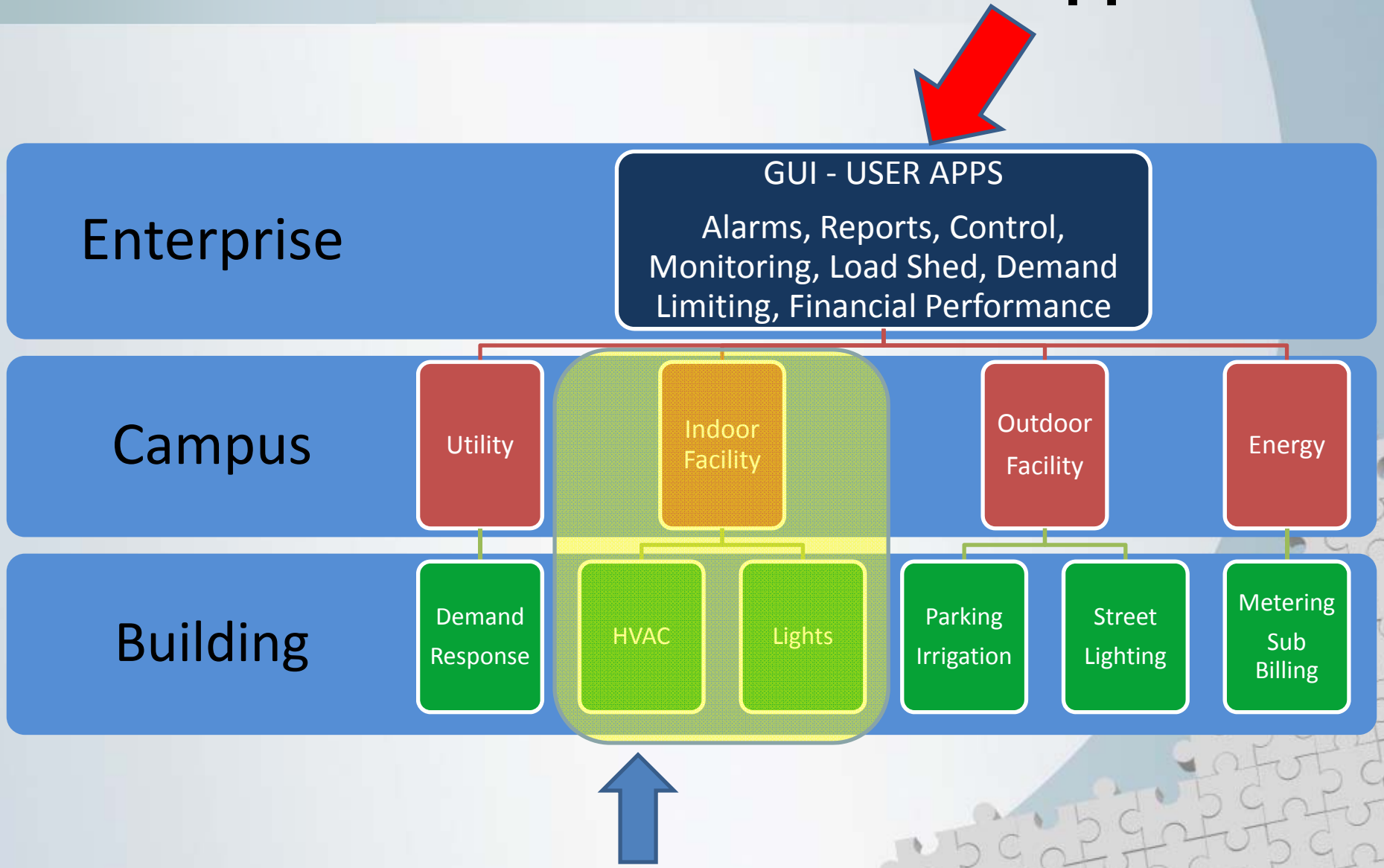
- Partial integration across silos
- Multiple open protocols
- Comms link to Internet

- Multi-protocol, cross-silo framework for new applications
- Dynamic load modulation
- Fine-grained load control

Smart Building Concepts

- Integration of multiple building systems
  - HVAC, Lighting, Energy, Emergency/Life Safety
- Common platform for data mining and exchange
  - Using open communications standards
  - Common infrastructure and data delivery mechanisms
- Enterprise data access
  - IT standards and communication interface
- Able to act and react
  - Internal and external influences
- Monitor, Alarm, Schedule, and Manage
  - Central or remote access
  - Variety of User Interface Options

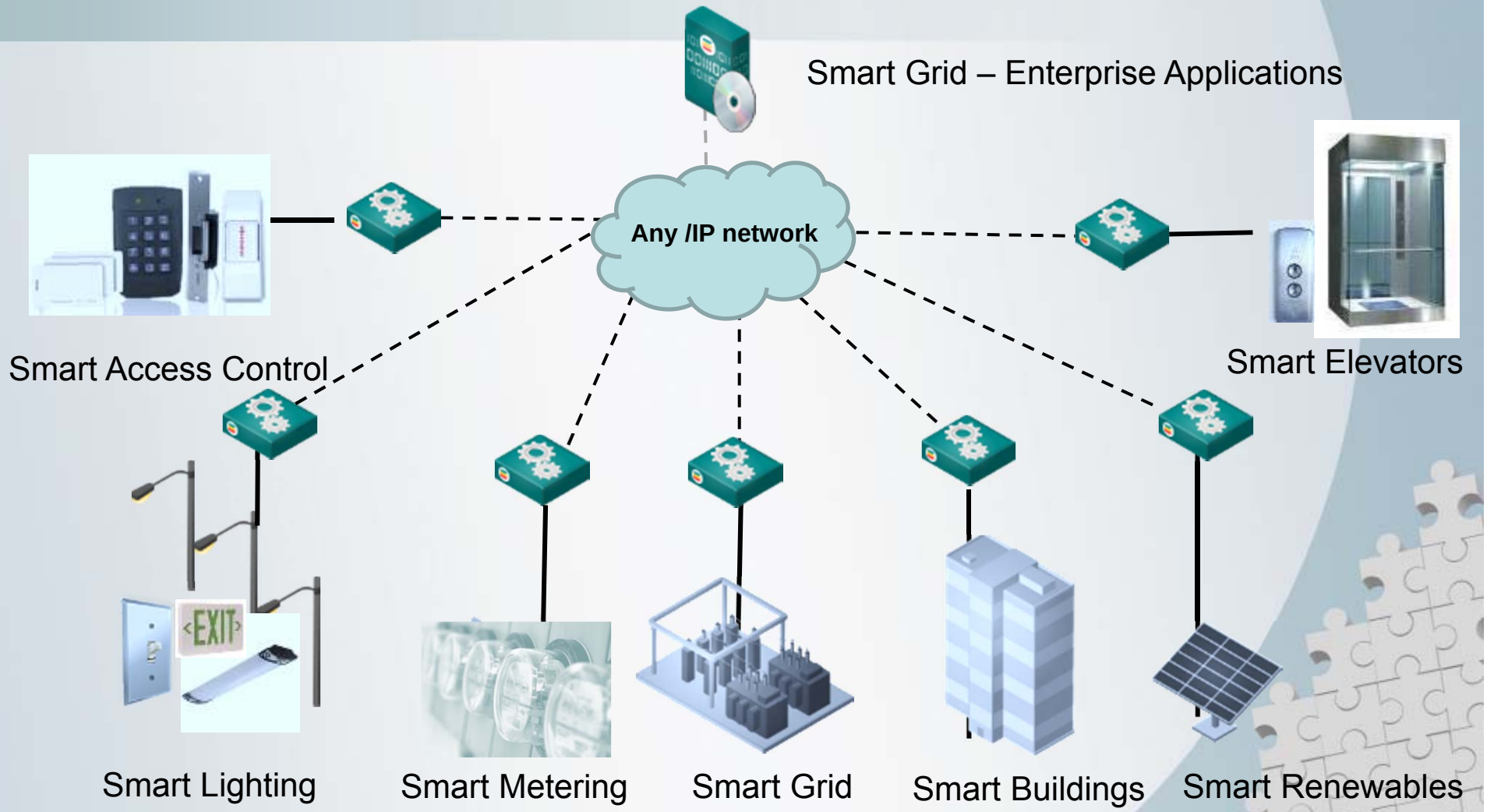
The Scope: Energy and Control A Holistic Approach



System Integration and Access

- Sharing data from sensors
  - Occupancy sensor data used by HVAC, Lighting, and Security
- Monitor and effect energy consumption
  - Used by demand limiting control strategy
  - Real time adjustments via control system
- Who's in control
  - Direct occupant control over environment
  - Facility staff control
  - Subsystem dependent - Lighting, HVAC, Security
- Alarm management
  - Single alarm, multiple recipients
  - Remote acknowledgement and response
  - Preventative maintenance based upon actual usage

Subsystem Intelligence
Smart Everything



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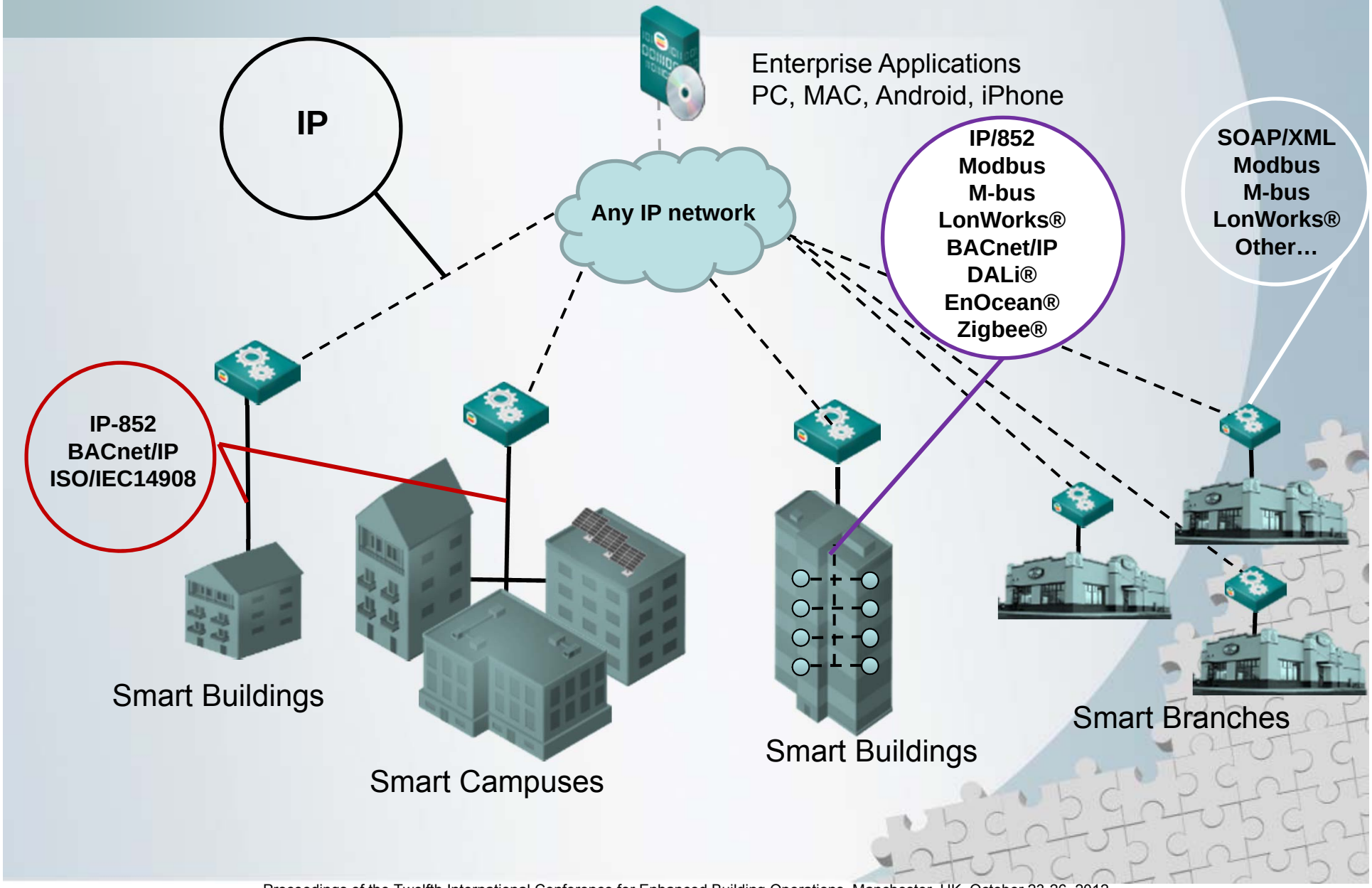
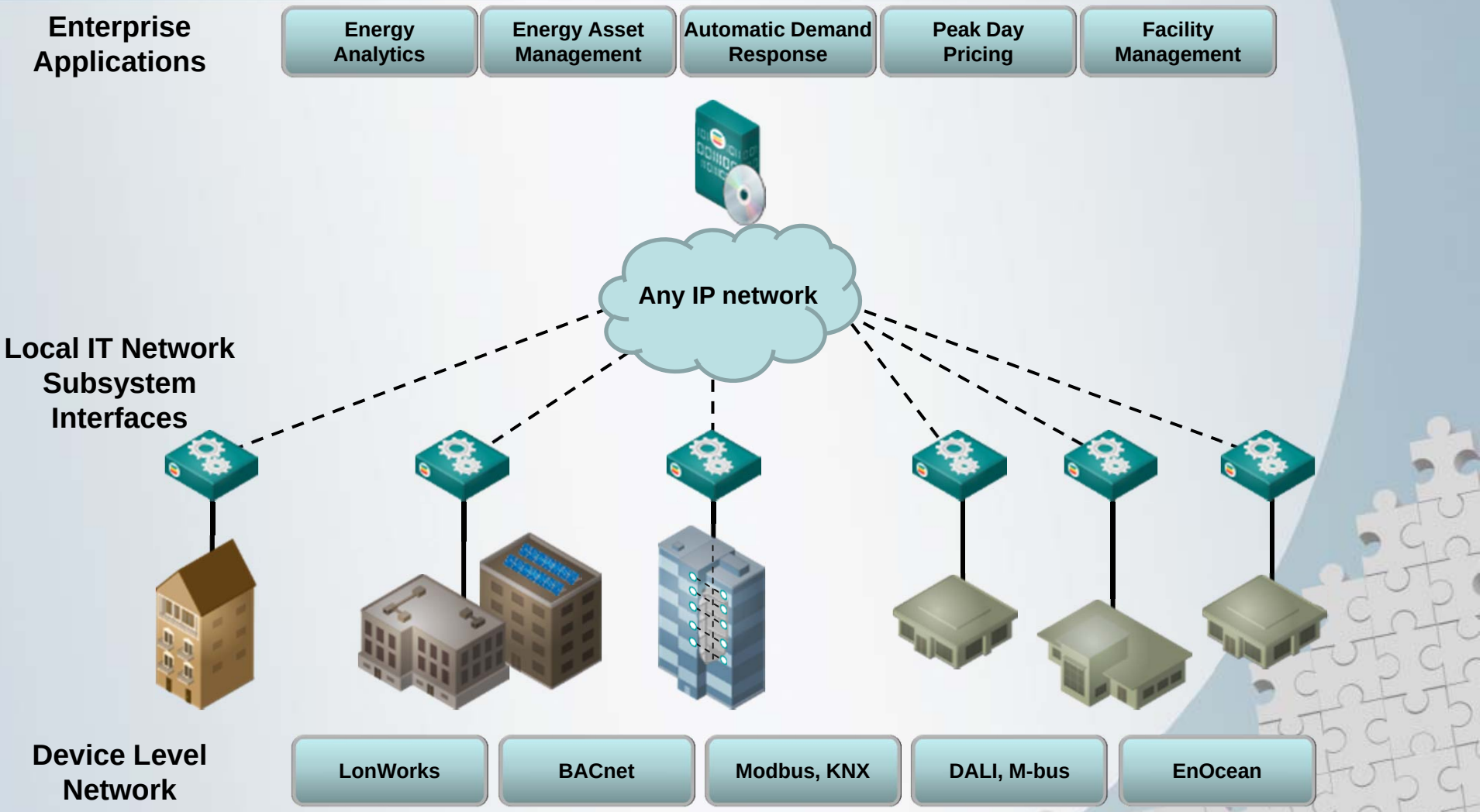
Standards-based Communication Common Data Models



Platform Example in Smart Building

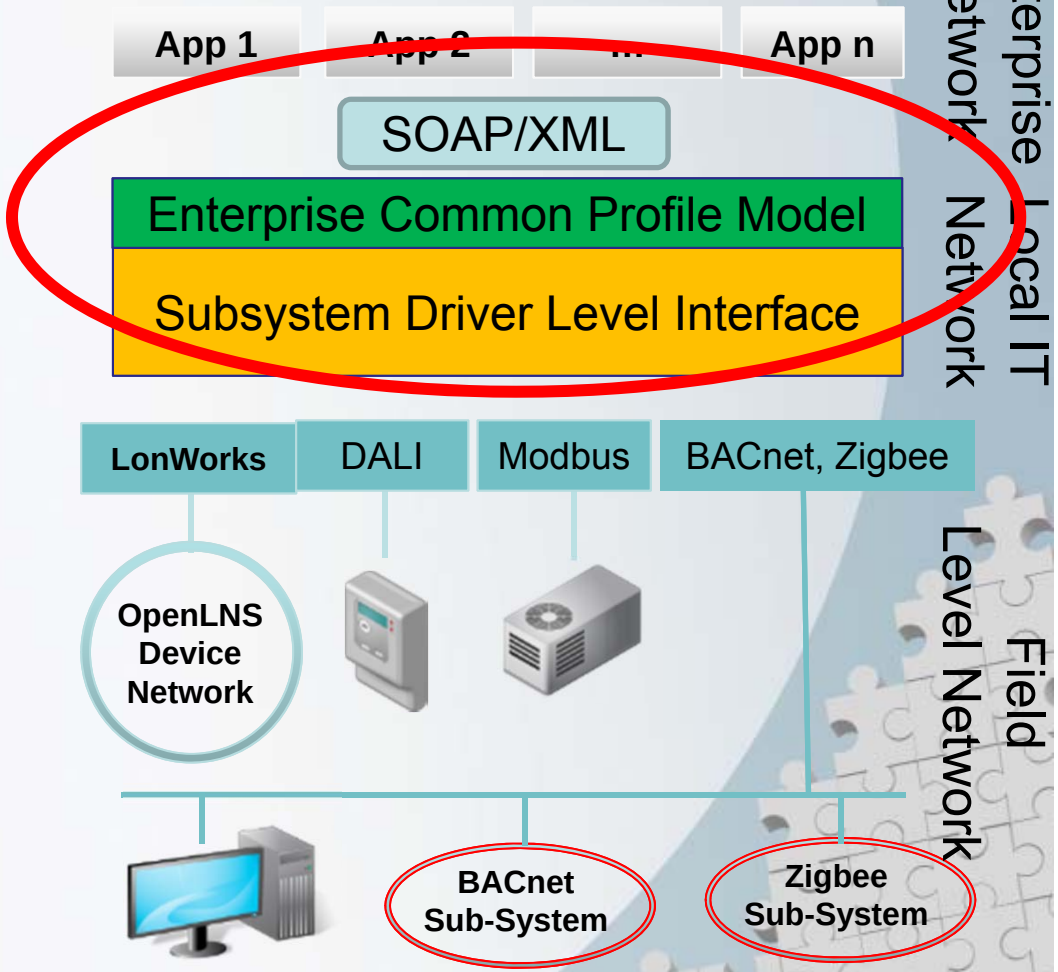
Need: Open at every level – From System to Device



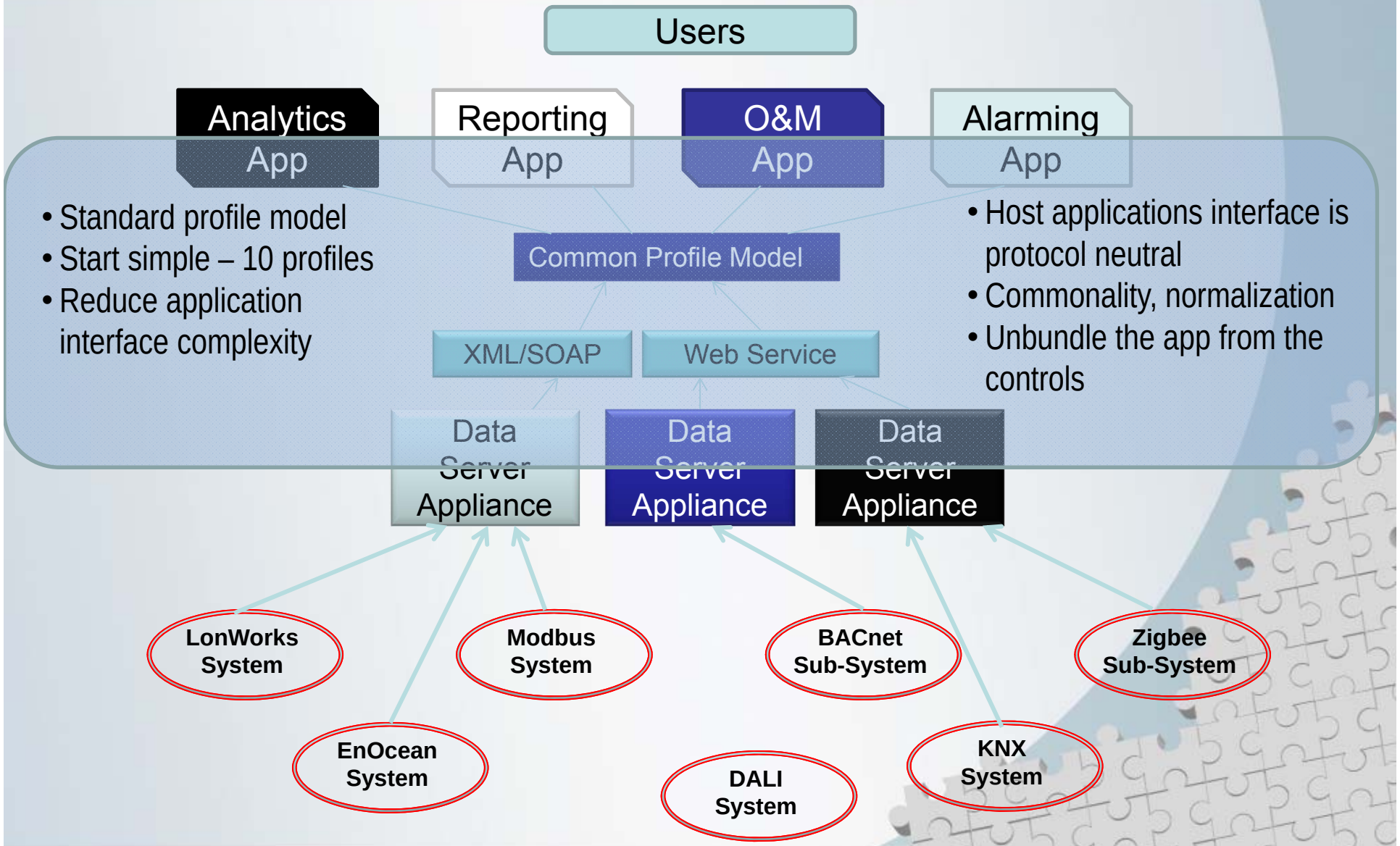
Common App Model

Mix and match best-in-class subsystems – One App interface

- Integrate LonWorks, BACnet, DALI, Zigbee, Modbus systems across IP
- Define common App interface using LMI Profile model
- Enable App independence from control network
- Multiple device networks – LonWorks, Modbus, M-bus
- Co-develop by LonMark, ASHRAE, DALI, Zigbee, TC-247, ???



Enterprise Application Standard Interface



Top Down - User Perspective

- User allowed to pick and choose Apps based on need, not bells and whistles
  - Solution is more open, less bundled
- Easier to specify multi-tier integrated solutions
  - App providers have common interface model to build to
  - Lower the cost for Apps
- Increases flexibility for integrators, installers
- Enable Demand Response type applications
  - OpenADR and LonMark Profile combined into one interface
- Better scalability and interaction across subsystems

EASI: Enterprise Application Standard Interface

- CEN/LONMARK/BACnet/ASHRAE Joint Working Group
- Enable App developers to work with any sub-system
- Protocol neutral networks interface to host Apps
  - Application independent interface model – co-developed
  - Scalable solutions for any application
- Support new interface and driver products from multiple suppliers
  - Sub-system level drivers/interfaces – implementing in local data servers
  - Common data modeling – Web Services using SOAP/XML
  - Potential for network management tools for managing multiple protocols in one tool environment

Security Issues

- Password levels and strength
- IP Ports Open/Closed
- IP Protocols – HTTP/HTTPS, FTP, UDP
- Secure Socket Layer (SSL) Certificates
- Encrypted communication
- Firewall pass-thru issues
- Bandwidth utilization
- IPV4 vs. IPV6 access
- Corporate standards necessary

Security Specifications

- Specify:
  - Password strength, passphrase minimums
  - Require password changed on install (no defaults)
  - SSL for WEB interface (HTTPS vs HTTP)
  - Install Security Certificates
  - Port Lock Down (FTP, UDP, TCP)
  - Firewall requirements (DMZ, Active Anti-Hacking)
  - Min/Max bandwidth requirements
  - IP Addressing Schema/Standards
  - Naming Conventions, Location Conventions

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Cloud Computing

- Databases hosted remotely
- Analysis performed remotely
- Compute hardware located remotely
- Software at the remote server
- Software-as-a-Service (SaaS)
  - Pay as you go
  - Pay only for what you need/use
- Security
  - Data ownership
  - System ownership

OR???

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Cloud Computing Concerns

- Who owns the data?
- Who owns the software?
- Up time minimum requirements
- What happens if cloud inaccessible?
- Fail safe and local fallback requirements
- Annual maintenance requirements
- Cost offsets for hosted vs. non-hosted systems
- Security and reliability issues

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Section Summary

- Facilities are and will continue to be multi-platform, multi-protocol, multi system
- Communication and data standards is critical
- New applications, new platforms, common data
- Communication at the building to the enterprise becoming mainstream
  - Security is critical – enforcement of procedures
  - Cloud computing evolving for BMS
- Find ways to make integration simpler
- New emerging standards and solutions supporting open integrated environments

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Specification Development Requirements

Specification Development – Phase 1

- Developing the scope
- Defining the team
- Basic data architecture elements
- Elements of the spec
- Master planning requirements
- Developing a sustainable approach
- Ensuring an open systems approach with interoperable products

Specification Development – Phase 2

- Writing the specification
  - Understanding the components
  - Define the scope and intent
  - Defining integration requirements
  - Defining cross system functionality
- Fair competitive bidding concepts
  - Three tier spec model
  - Following standard design principles

Specification Development – Phase 3

- Technology selection
- Product selection
- Contractor responsibilities
- System integrator qualifications
- Master system integrator requirements
- Specification enforcement

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The Purpose of the Spec

- To define the sequences, functionality and architecture of a controls system required to ensure the affected systems (mechanical, lighting, access etc.) function and perform per the engineers intent.

- Make the system work!

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The Value of a Good Spec

- Write the spec to the performance of the system, not the parts and pieces
- Write a spec that various applications of the technology be applied
  - Mechanical, Lighting, Access, Energy, etc.
- Focus on system functionality
- Not on product features, bells and whistles

Project Team Development

- Develop a “TEAM” approach
  - Owner, Project Management, IT, Facilities, Engineering/Design, Architecture, Contracting, Financial, Integrators
- Set a clear vision for the project
- Establish domain expertise (team leaders)
- Define cross domain interactions
- Develop information stratification model
  - (WYSIWYNTS – “What you see is what you need to see”)
- Define information flow
- Enable cross domain interaction
- Establish “Human Factor” Issues
- Educate team fully – share cross domain knowledge
- Get team “commitment to success” – no “NIH” holdouts

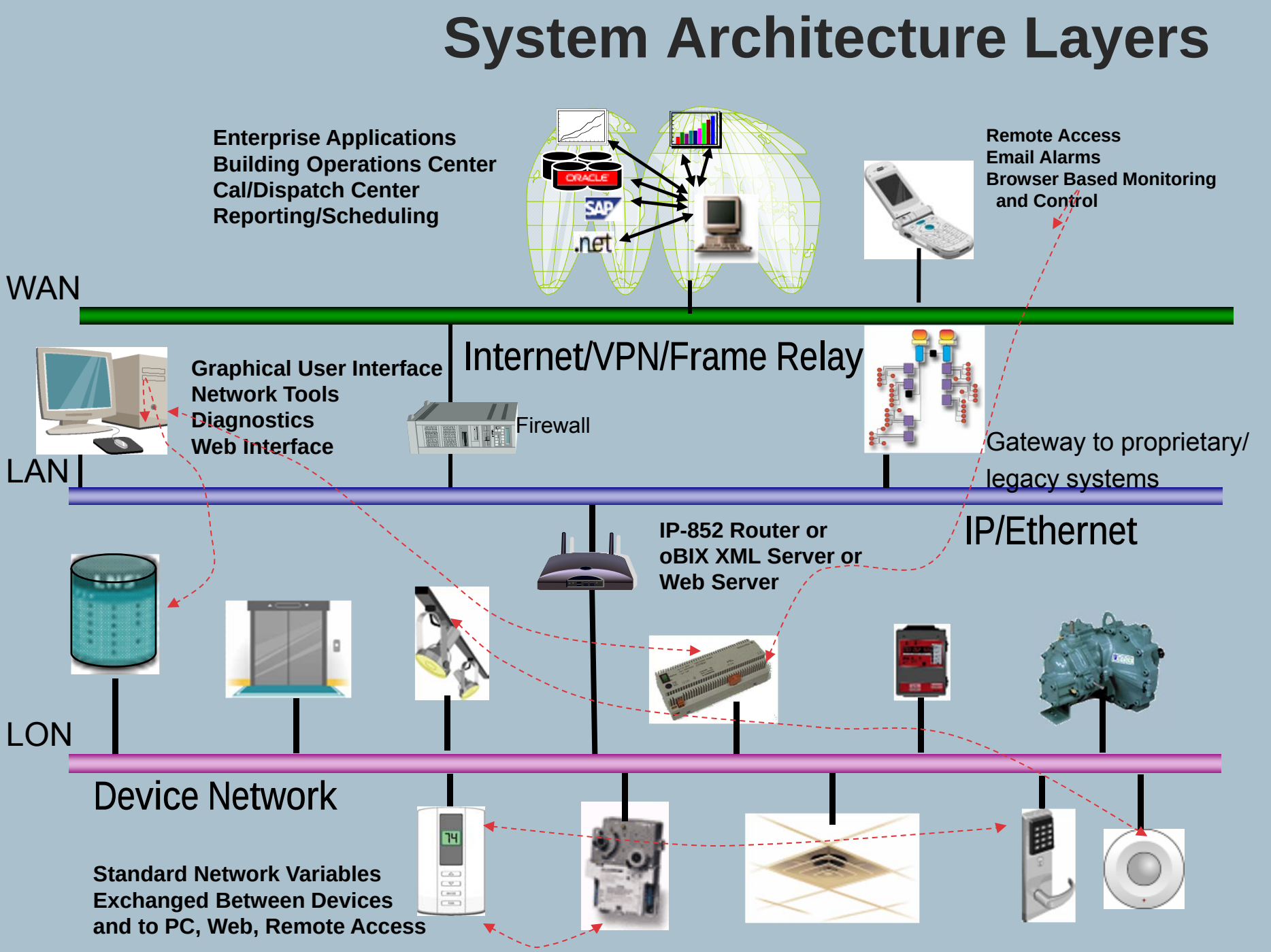
Project Scope Development

- Owner/Owner Advocate Responsibility
- Single facility or multiple facilities
- One time installation or long term plan
- Coordination with facility master plan
- Set objectives and priorities
- Key project drivers
  - Energy Efficiency
  - Improve Operational Performance
  - Improve Comfort
  - Reduce Maintenance
  - Full or Partial System Integration
  - Common GUI
  - Fair Competitive Bidding

Basic System Architecture

- Define data flow
  - Peer-to-peer communication
- Define level of IP integration
  - Host workstation interface
- Define common GUI needs
- Define enterprise integration
- Define remote access requirements
- Engineer basic system structure
  - LON – Local Operating Network (control)
  - LAN – Local Area Network (monitor)
  - WAN – Wide Area Network (remote)

System Architecture Layers



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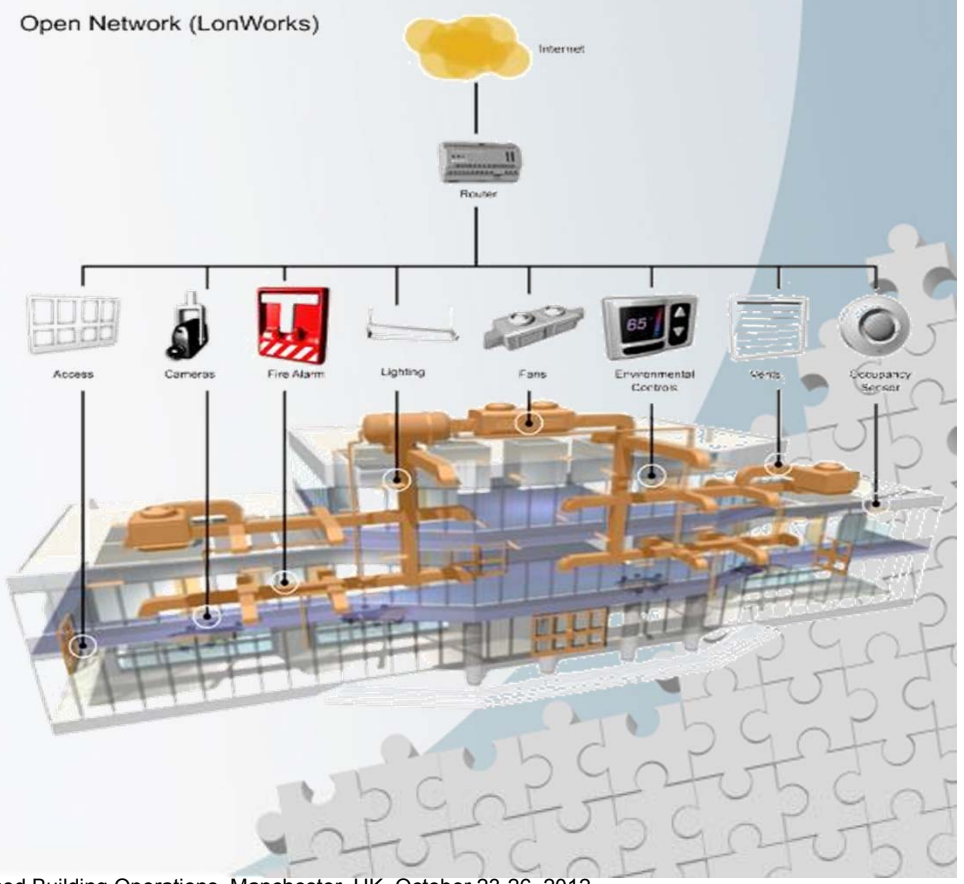
System Integration

- Define integration scope
- Define level of integration of sub-systems
  - HVAC
  - Lighting
  - Security
  - Metering
  - Energy
- Define cross system information flow
- Legacy system integration



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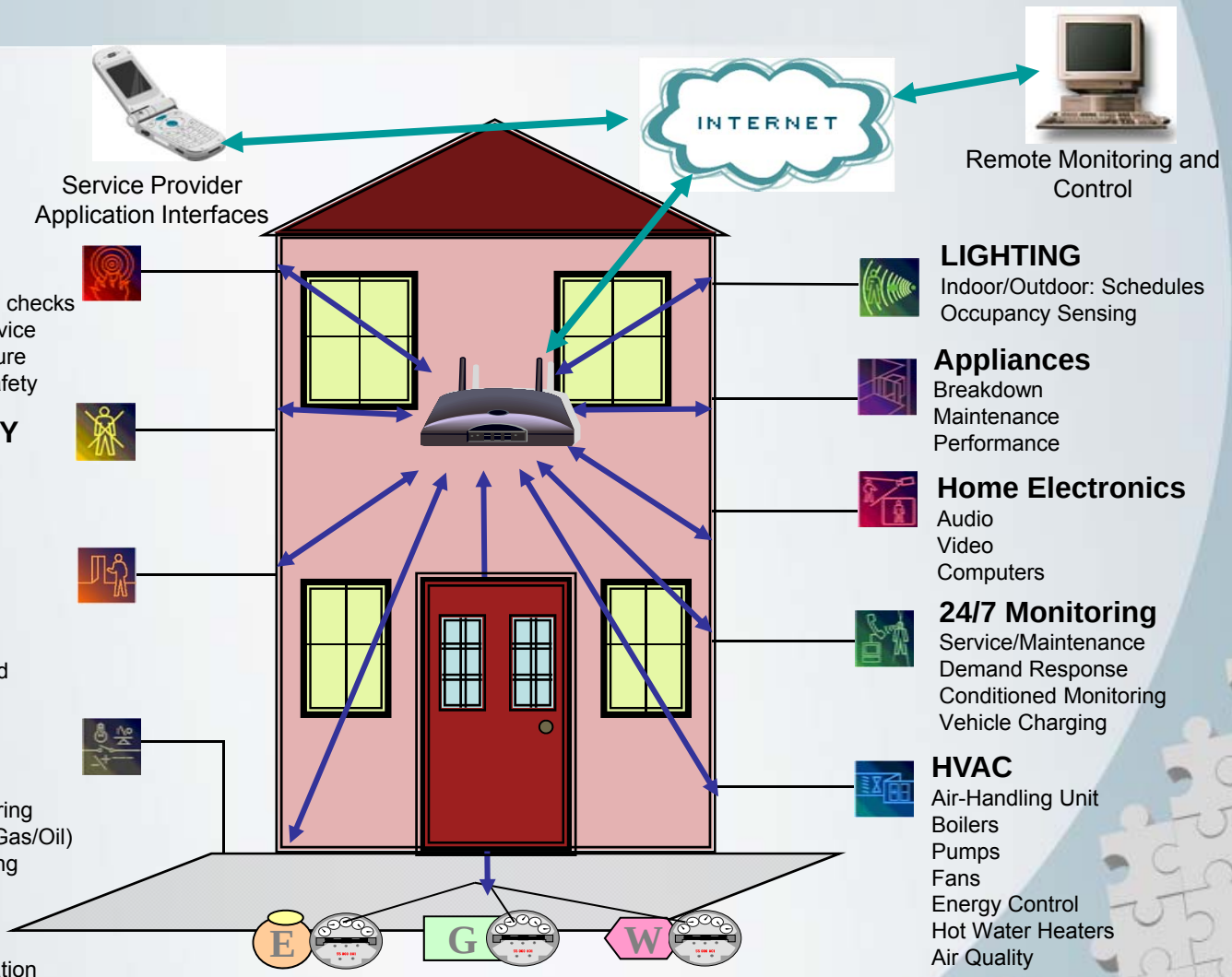
System Integration Complexity



Product Interoperability

- Define interoperability requirements
- Control network protocol
  - Field level device interoperability
  - Ensure/enforce compliance
- Network media type(s)
  - Installation reliability and cost issues
  - Free topology wire, Powerline, IP, WiFi
- Functional interoperability
  - Devices tested to meet strict certification requirements
  - Functional profile compliance
- Define enforcement vs. exception rules
  - What are you willing to live with/without?

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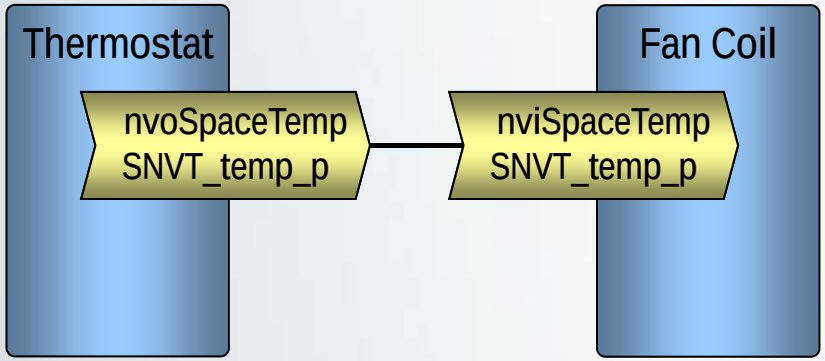
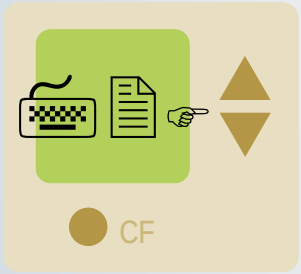
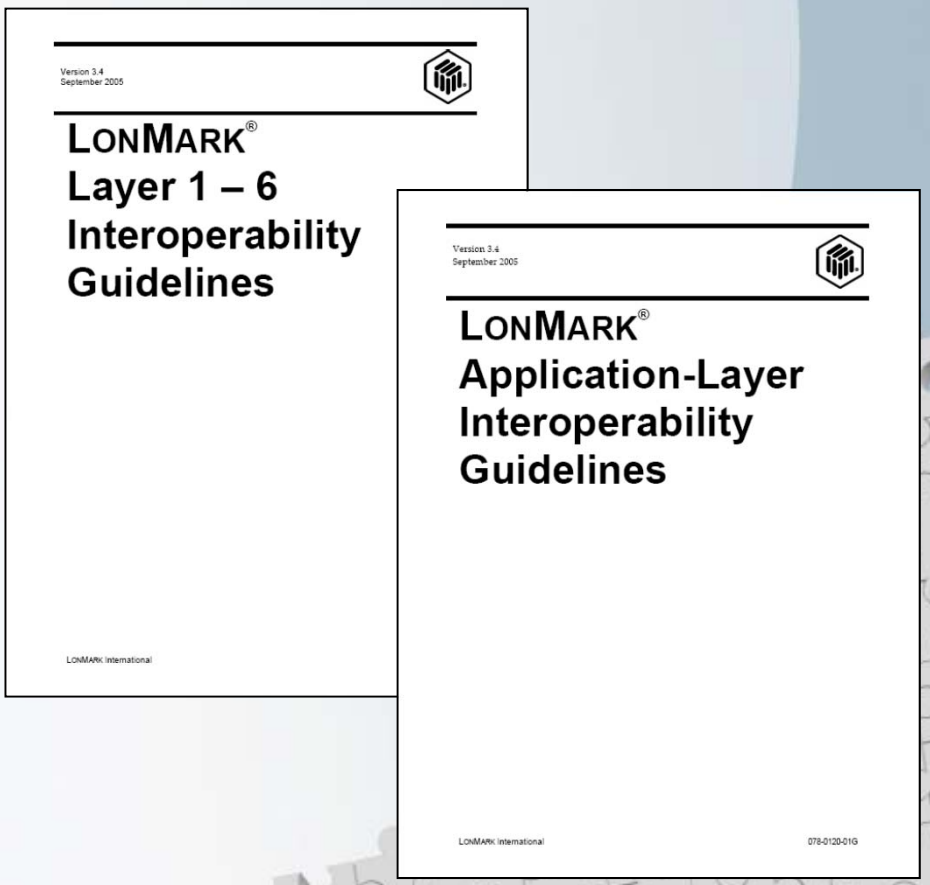
LONMARK Interoperability with Network Variables





Standard Network Variable Type



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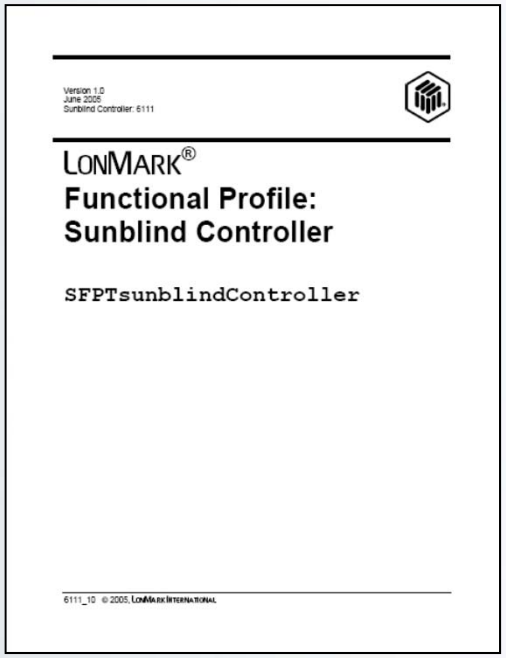
LONMARK Functional Profiles

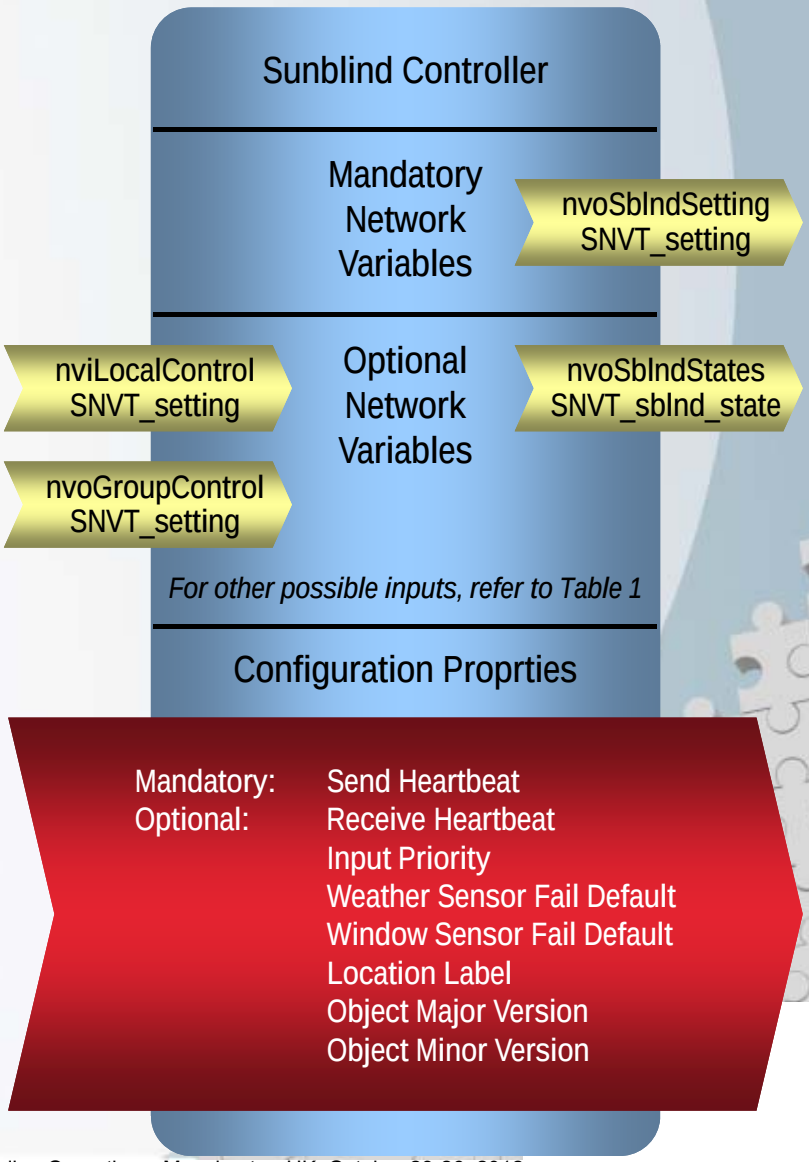


Version 1.0
June 2005
Sunblind Controller: 6111

LONMARK®
Functional Profile:
Sunblind Controller

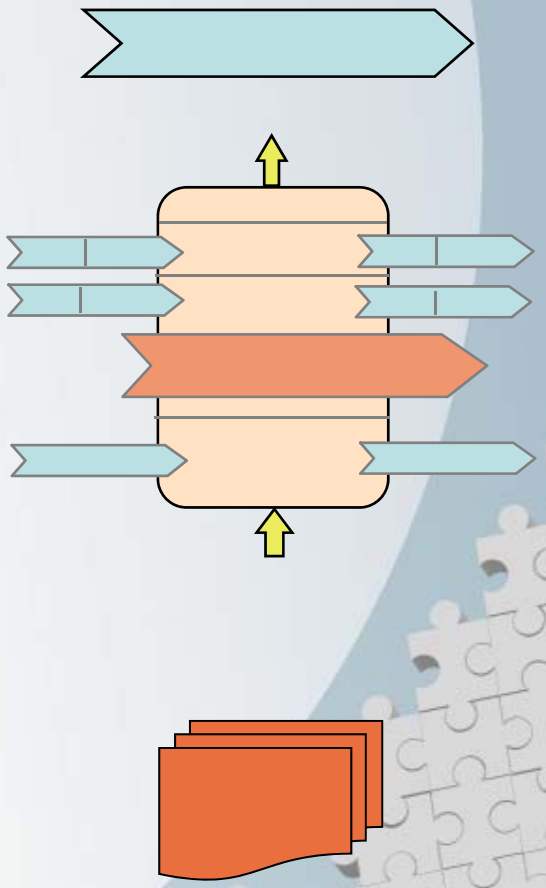
`SFPTsunblindController`

6111_10 © 2005, LONMARK INTERNATIONAL



LONMARK Interoperability Guidelines

- Data interpretation
  - Standard representation of data types
- Standardized functional behavior of a nodes
  - LONMARK objects
  - encapsulated network interaction of defined functions
- Standardized support of smooth and trouble free installation
  - Self documentation of a network oriented external interface
  - Guidelines for Network Management

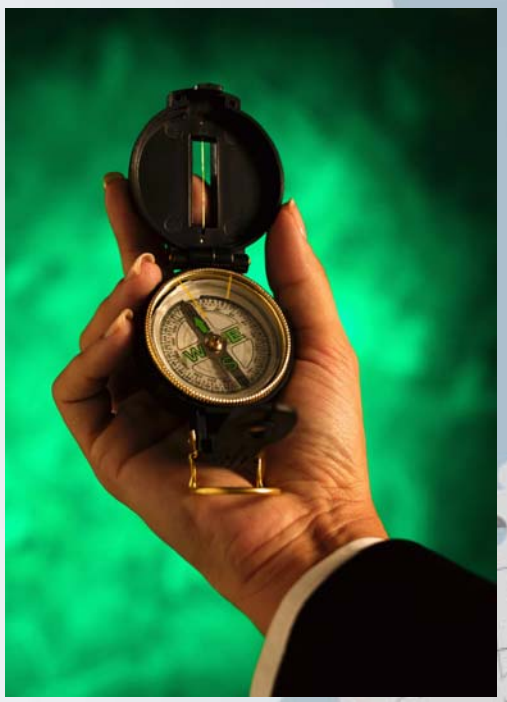


Writing an Integrated Controls Spec: The Challenges

- CSI Master Spec format (Construction Specification Institute)
- Division of labor doesn't support integration
  - Competitive issues must be addressed
- Change orders are profit centers
- Risk avoidance
- Incomplete or ill defined specs
- Control vendor specific specs
  - Be cautious about solution specific specs
  - Embrace a more open approach
- Look to vendor and technology neutral sources for help and support
  - LonMark International can help

Legacy System Integration

- Which Direction?
  - Upgrade
    - As systems fail, replace with new controls
    - Move to a more open model
  - Replace
    - “Dumpster retrofit”
  - Integrate
    - Gateways, gateways, gateways = $$$
- Multiple Factors
  - Life Cycle
  - Functionality
  - Reliability
  - Initial Costs



The Components of a Good Spec

- Text
  - Define Scope and Intent
  - Define Functionality
- Drawings (and as-builts)
  - These are separate, but important
- Call-outs
  - Provide back up details so there is no confusion
- Points List
  - Detailed hard points, trend points, alarm points etc.
- Minimize misunderstandings and discrepancies

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Foundation of an Open System

- Products from multiple vendors interoperate
  - Common physical interface - transceiver
- Tools from multiple vendors interoperate
  - Common network management model - LNS
- Opens up for fair competitive bidding
  - Unbundling hardware from software from engineering
- Enables owners to “own” their systems
- Removes the “Locks”
- Reduces costs, improves efficiency
- International standards enforcement

Essential Elements of an Open System

- **Devices**
  - The controllers on the network
  - Applications specific devices
  - Programmable devices
  - Packaged equipment
  - Scheduling, Alarming, Data logging
- **Infrastructure**
  - The wire the nodes connect to
  - The routers that pass the data
  - Termination
  - Traffic/bandwidth issues
  - Systems architecture
  - IT Routing
  - When are gateways necessary?
- **Host Interface**
  - PC Based
  - Web Based
  - Integrated Graphics
- **Tools**
  - Design Tools
  - Commissioning Tools
  - Database issues
  - Configuration Plugins
  - Scheduling, Alarming, Data logging, Overrides
- **Enterprise Connectivity**
  - IT Interface
  - Large project architecture
  - Design for the future
  - Scalability issues
- **Life Cycle**
  - Long term service contract
  - Staff training
  - Sustainable design

Don’t get locked in!

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Top 10 List to Open Systems

1. Open Communication Protocol
2. Device Interoperability
3. Infrastructure Standard
4. Open Tool Sets
5. Graphical Interface Interoperability
6. Integrator Proficiency
7. Contracting Requirements
8. IT Integration
9. Vender Selection Criteria
10. System Performance Standards

11. Bonus Issue - Specification Compliance

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The Questions

1. Can devices from different manufacturers be installed and commissioned on the same physical wire and be capable of true peer-to-peer communication?
2. Have devices been tested for interoperable compliance; and are there any closed aspects of these products inhibiting an open system?
3. Is the network infrastructure adequate and correctly installed?
4. Are network management and commissioning tools capable of completely installing **all** nodes in the system?
5. Are the front-end tools truly open and non-proprietary?
6. Are the people doing the work qualified, certified, credentialed?
7. Do you have control over your building and access to **all** data points, tools, and databases?
8. Is the connection to your data network based on open standards?
9. Are the controls and products openly available from multiple sources?
10. Is there proof your network was designed and installed correctly?

BONUS QUESTION: Are you about to undermine all of your efforts?
No Alternates Will Be Accepted.

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The Questions

1. Can the devices from different manufacturers be installed and commissioned on the same physical wire and be capable of true peer-to-peer communication?
"All devices on the network shall be capable of true peer-to-peer communication, without requiring a host or zone controllers. Logical layer 3 routers shall be used to logically isolate channels of devices.“

2. Have the devices been tested for interoperable compliance? Are the manufactures of the device level product adhering to interoperable standards when designing and delivering their products? And are there any closed aspects of these products that would inhibit and open system in which they are intended to be used?
“All devices shall implement the ISO/IEC 14908-1 protocol standard and shall do so using standard mechanisms for sharing data as defined by LonMark International. Applications specific devices shall be LonMark Certified only. Closed or non-standard communications protocol implementations will not be accepted. All devices (nodes) on the network shall conform to the LonMark International Interoperability Guidelines and be tested for compliance on the open systems network.”

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The Questions

3. Is the integrator meeting the requirements for the network infrastructure?
"The network infrastructure shall conform to the published guidelines for wire type, length, number of nodes per channel, termination, and other relevant wiring and infrastructure criteria as published (see reference documentation)."

4. Are there network management and commissioning tools available from multiple sources that can completely install all the nodes in the system?
"All devices (nodes) on the network shall be able to be installed and configured using a standard network management tool as defined by the LonMark System Definition. No closed or partially closed tool set for installation or configuration will be accepted. All tools must be generally available for purchase to any integrator from multiple sources. Complex devices shall be configured with a vendor supplied LNS plug-in."

The Questions

5. Are the front-end tools open?
"Any host PC GUI interface shall use openly available software packages that are non-exclusive. No closed software will be accepted. Software must be generally available on the market from multiple sources. Devices must communicate to the GUI workstation using Standard Network Variable Types (SNVT) Standard Configuration Property Types (SCPTs) as defined by LonMark. No non-standard communication to devices will be allowed."

6. Who is doing the work on your building?
"Integration of the controls network shall be performed by a qualified network integrator. A qualified network integrator must have technical staff members who have attended at least 80 hours of LonWorks network design and network management tool training and have passed the LonMark Certified Professional exam. It is also recommended that the integrator have staff members competent in IT connectivity and advanced troubleshooting of LonWorks networks. The integrator shall provide references of prior successful LonWorks open systems jobs experience. The Network Integrator must demonstrate their ability and intent to design, architect, and install a open, flat,, LonWorks system and have on staff at a minimum two technically trained members."
Or simply state "Integrator must be a LonMark Certified System Integrator"

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The Questions

7. Do you have control over your building?
"All configuration tools, installation tools, Plugins, databases, software shall remain with the job and be owned by the property. All software tools shall be properly licensed and conveyed at contract sign-off. No exclusive or non-open integration tools, devices, or host software shall be used as part of this open system"

8. How are you connecting to your data network?
"If Internet or IP connectivity is specified, all devices connecting to the LAN shall use the TCP/IP protocol stack. Any LAN to LON routers shall use the ANSI/EIA-852 standard layer 3 transparent routing protocol. Specific IP interconnectivity shall follow IT standards for security, firewalls, address, etc. published in separate documents (if appropriate)."

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The Questions

9. What controls are you using?
"The control system shall be installed using the best available products from the currently available suppliers that meet the system specification. Controllers from multiple manufactures are encouraged."

10. Are you certain your network was designed and installed correctly?
"The system integrator shall provide a protocol analyzer log summary for each channel for a minimum of 24 hours showing system performance. The statistical summary shall show that all bandwidth utilization and error limits are within acceptable ranges and that there are no network traffic problems, node communication problems, or system sizing problems.

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Bonus Question

11. Are you about to undermine all of your efforts?

No Alternates Will Be Accepted.

Submittal documents and drawings must adhere to both the scope and details of this specification.

Bidders must prove they will deliver the open system specified and provide a complete, working, serviceable system.

Bidders must include service contract costs for 5 years as a separate cost, not included in the initial installation. Annual costs shall be identified for each successive year.

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Workshop Discussion Question #3

What are the challenges, obstacles, and blocks to getting more efficient facility management?

Total Facility Control

Results of Prior Workshops

- Lack of training and education
- Venders “hide” information from owners
- We don’t “own” our systems
- Competitive bidding issues – can’t get “Apples-to-Apples” bids
- Lack of good specifications – lacking detail
- We can’t control our facilities because we can’t see the data – minimal control
- We can’t find qualified integrators

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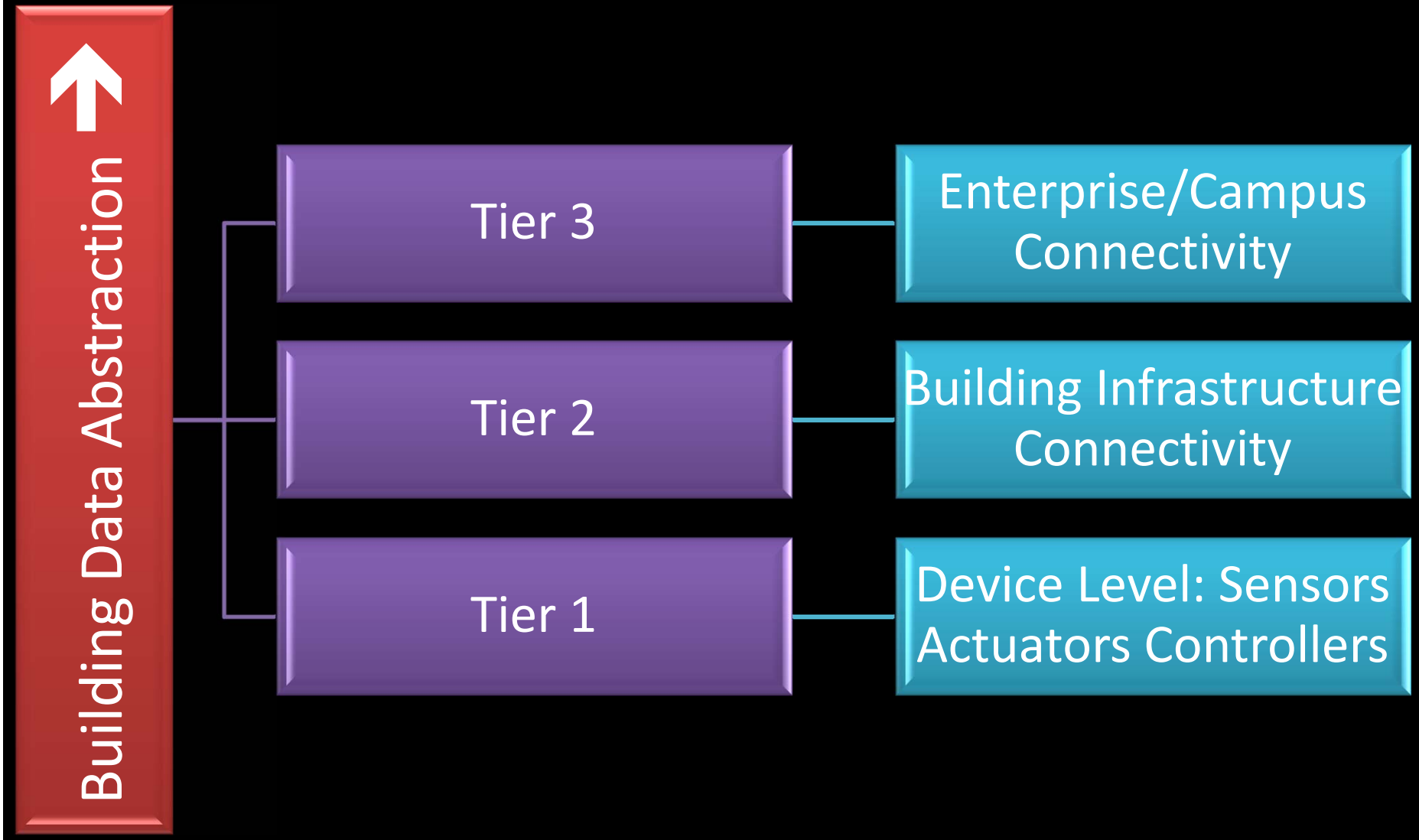
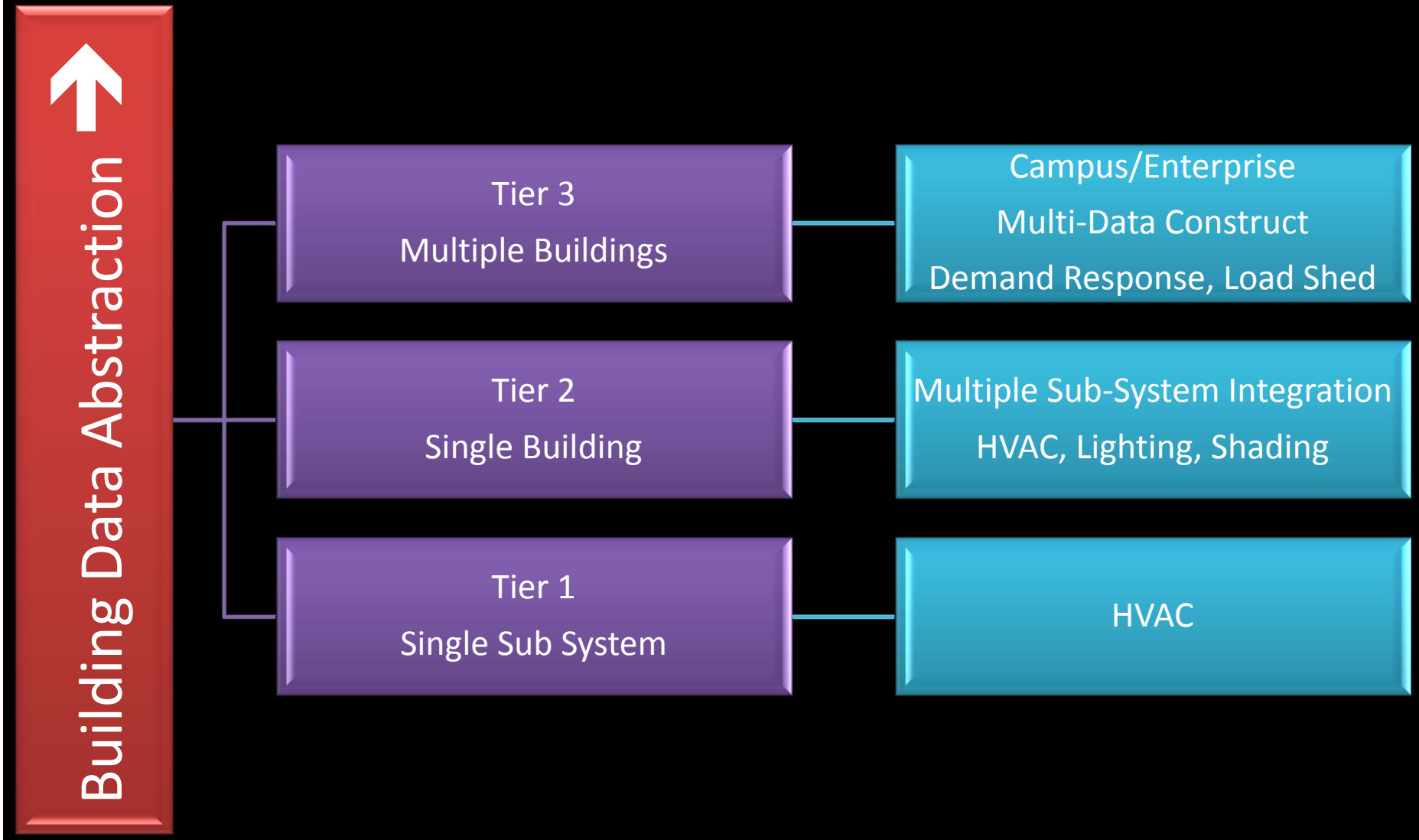
Introducing the Three-Tier BAS/BMS/EMS Spec

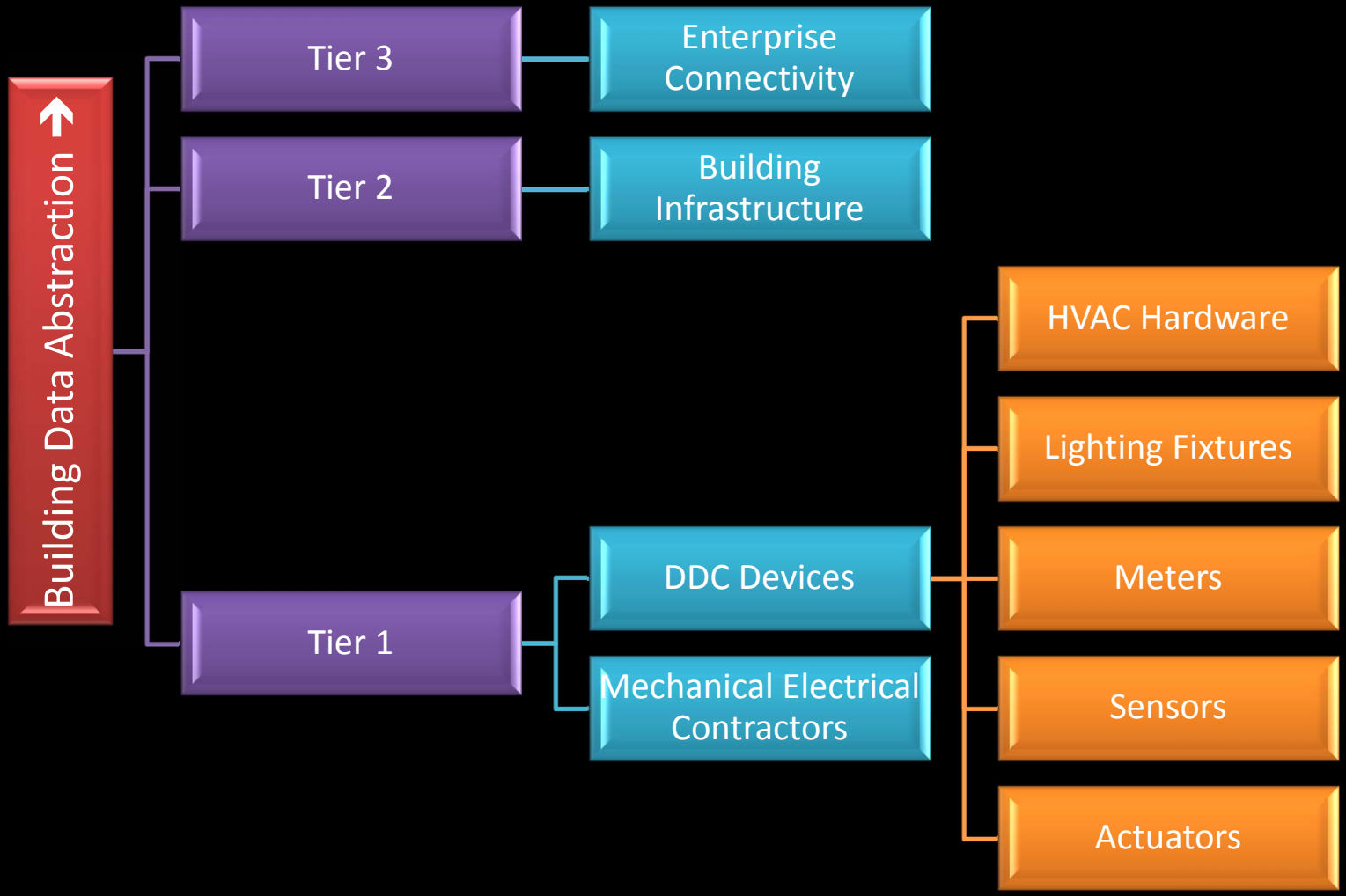
3-Tier Architecture



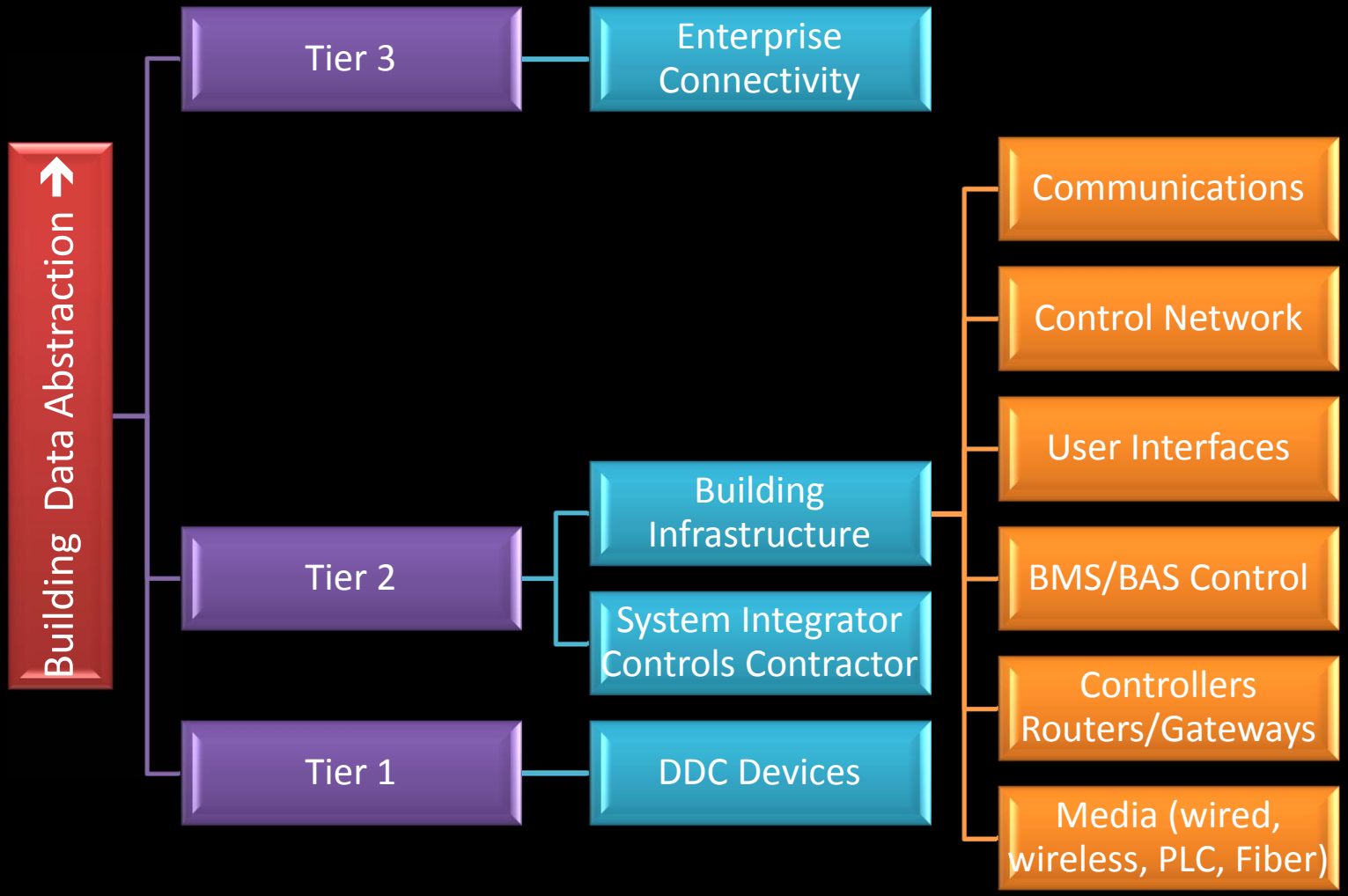
3-Tier Architecture



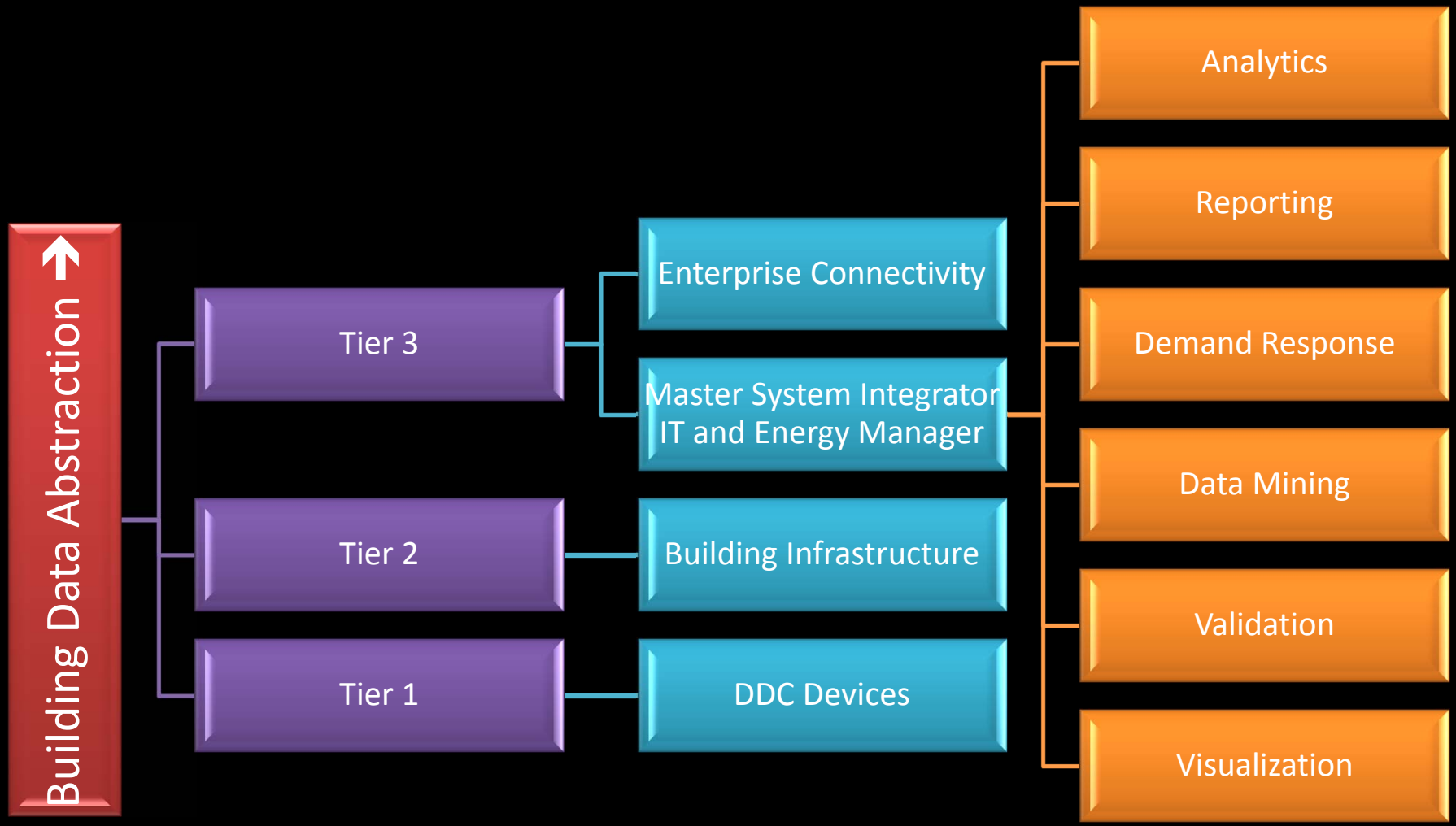
Tier 1 - DDC Devices



Tier 2 - Infrastructure



Tier 3 - Enterprise Connectivity



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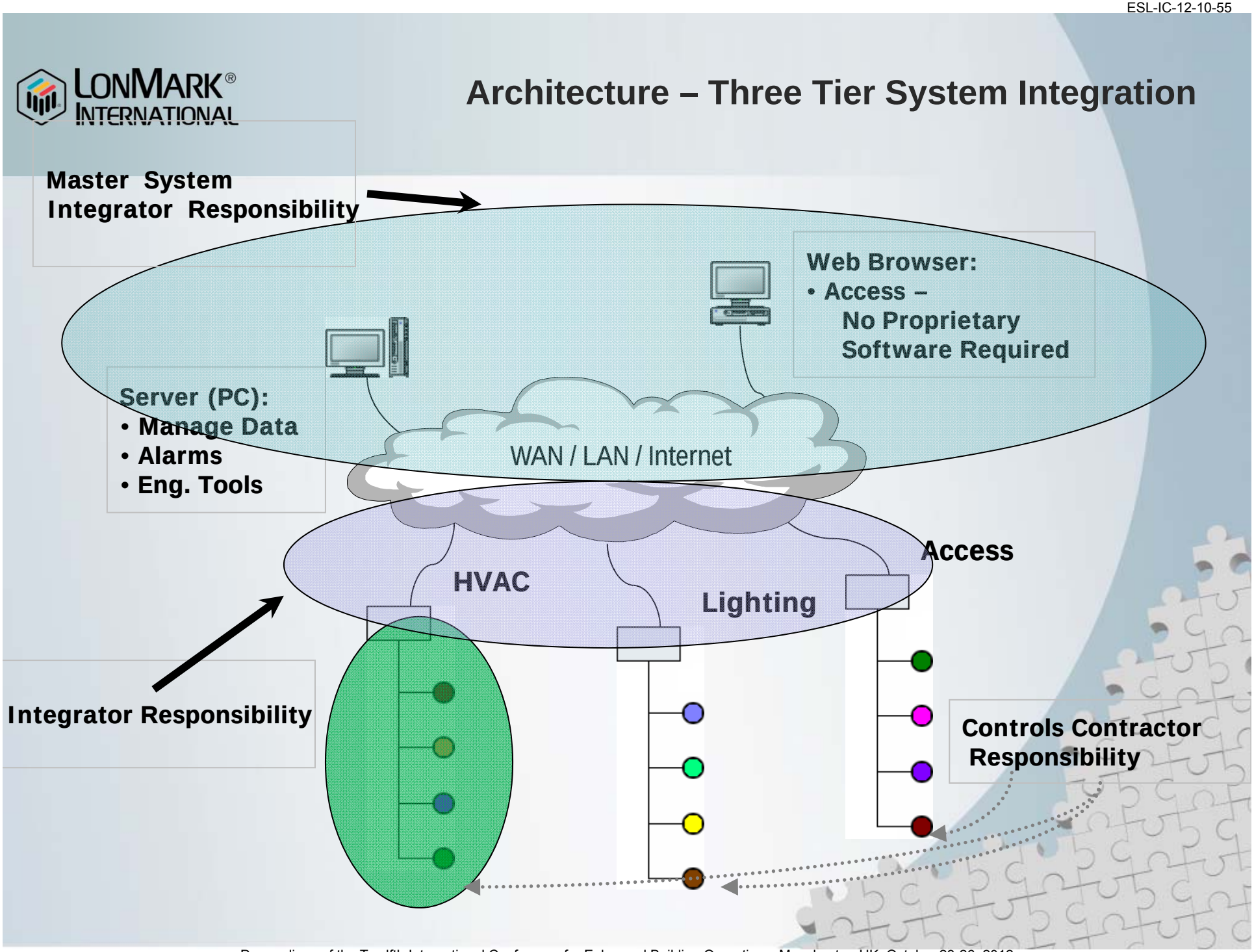
Division of Responsibilities

- T1 - Traditional Controls Contractor
  - Hired by Mechanical/Electrical Contractor
    - Only sees his scope, typically one sub-system
    - Limited or no integration
- T2 - System Integrator
  - Performs and or manages all work related to Building Automation Systems
    - Better integration capabilities
- T3 - Master System Integrator
  - Manages the work at the network level and higher
  - Acts as the owner rep to manage the System Integrators work
  - Long term relationship
  - Applies to larger Multi-Building systems, longer term projects
  - Allows for easier management of multiple vendors

Three Tier Specs

- Tier 1: Sub-System Spec
  - Field device bus, monitoring/control – single sub-system focused
  - Performed by controls contractor (system integrator)
  - Often hired by Mechanical Contractor
- Tier 2: Integration Spec
  - System and cross system functionality
  - Multiple Sub-system interaction
  - Cross system sequence of operations
  - Hired by General Contractor
- Tier 3: Enterprise Integration/IT Spec
  - Integration of multiple building into campus/enterprise
  - IT and GUI integration
  - Facility Master System Integrator
  - Hired direct by owner
- Provides check and balance
  - Reduces “Lock-in”
  - Encourages fair competitive bidding
  - Provides options for long term service

Architecture – Three Tier System Integration



NASA – Introduced the Concept

- Scope
  - Kennedy Space Center - Florida
  - Upgrades to existing control systems – built in the 70s – started in 2002
  - Multi-year, multi-phase project
  - Open bidding process across multiple projects/buildings
  - One Common Front End
- The Spec
  - Calls for LNS, LONMARK, and IT connectivity into existing Citect SCADA front end
- Status
  - Several projects underway using spec
  - Multiple bidders winning jobs

NYC Schools
Enhanced Concept - Developed 2 Tier Spec

- Scope
  - 1200 buildings
  - Upgrades to existing pneumatic systems
- The Spec – Started in 2002
  - Has two components
    - Building level
    - Enterprise connectivity
  - Bidders on the buildings cannot bid on the enterprise and vise versa
- Specs released in January 2004
  - Multiple buildings bid and won by multiple controls contractors
  - Master Systems Integrator (MSI) contract awarded

Army Corps of Engineers Broad Adoption Across Multiple Facilities

- Two level specification – Started in 2003
  - Calls for open LONMARK certified devices, LNS® network management and LNS plug-ins for all devices
  - Identifies building and integration requirements in different spec docs
- Released Sept 2004
  - "Tri-Branch" spec - Army, Navy, and Air Force
- CorpsLON enforcement and support
- Spec being used by other government and commercial organizations

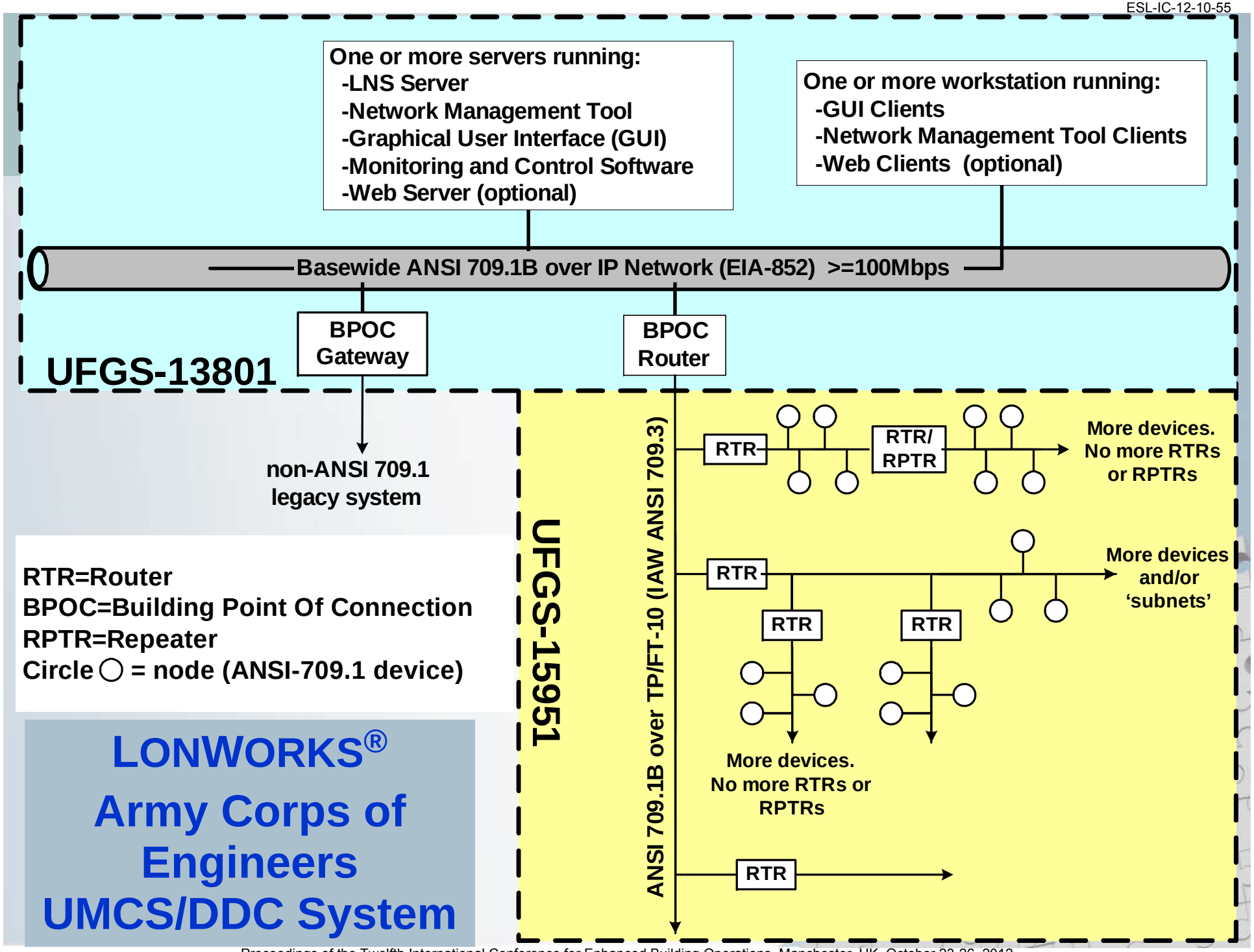
Open System Goals

1. *One system*. Multiple buildings with controls installed by multiple vendors are integrated into one system.
2. *One common front-end* that provides users with the capability to interface with all buildings (monitoring, supervisory control, etc.).
3. *One common tool* for network management and device configuration. One common tool for device programming would be great!
4. *No future need for* the original (installing) contractor or any particular device manufacturer. Additions, modifications, and retrofits can be easily (without significant additional cost) made to the system without dependence on the original contractor nor require substantial engineering or other technical development.

US Army Corps of Engineers

IMCOM BAS Workshop, Chicago IL
August 2008

Slide 7


One or more servers running:
-LNS Server
-Network Management Tool
-Graphical User Interface (GUI)
-Monitoring and Control Software
-Web Server (optional)
One or more workstation running:
-GUI Clients
-Network Management Tool Clients
-Web Clients (optional)
Basewide ANSI 709.1B over IP Network (EIA-852) >=100Mbps
BPOC Gateway
BPOC Router
UFGS-13801
non-ANSI 709.1 legacy system
UFGS-15951
ANSI 709.1B over TP/FT-10 (IAW ANSI 709.3)
RTR
RTR/ RPTR
More devices. No more RTRs or RPTRs
RTR
More devices and/or 'subnets'
RTR
RTR
More devices. No more RTRs or RPTRs
RTR
RTR=Router
BPOC=Building Point Of Connection
RPTR=Repeater
Circle ◯ = node (ANSI-709.1 device)
LONWORKS®
Army Corps of Engineers
UMCS/DDC System

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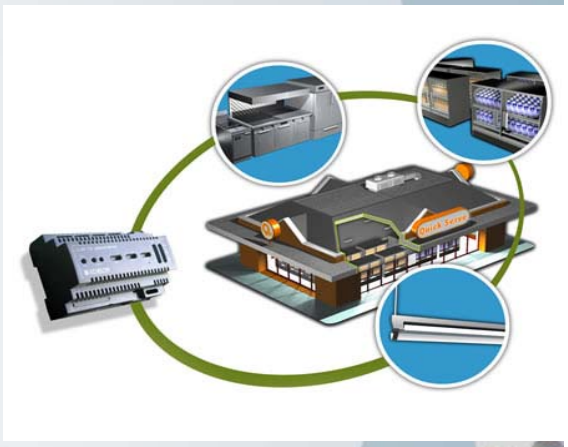
Use Case Examples

McDonalds and QSR Market

- Scope
  - QSR (Quick Serve Restaurants) Smart Networked Kitchens
  - Enable networked intelligent kitchen equipment
- Application/Need
  - Energy savings
  - Operational efficiency
  - Integration of process and facility
  - Enterprise Dashboard Applications
- Impact
  - 5000 restaurants installed
  - Thousands more planned
  - Entire QSR supplier marketing supporting effort
  - Potential adoption by entire QSR Market (KFC, YUM!, Wendy's, etc)
- Status
  - LonMark Sponsor, Board Member, Driver
  - LonMark Certified Smart Kitchen Equipment
  - Integrating process to facility
  - Building automation and restaurant automation
  - Enabling access to enterprise applications (NEEDED!)
  - "If you build it, they will come" model
  - LonMark driving industry support with NAFEM Committee



California State Office of the Courts – State GSA

CALIFORNIA COURTS
THE JUDICIAL BRANCH OF CALIFORNIA

JUDICIAL COUNCIL OF CALIFORNIA
ADMINISTRATIVE OFFICE OF THE COURTS

- Scope
  - 550 building management systems statewide
  - Court Houses
  - Office facilities
  - Multi-story, multi-use facilities
- Application/Need
  - Focus on Energy Savings, Operational Efficiency (COST SAVINGS)
  - One common front end access for ALL facilities
  - Network access using web browser and IT tools
  - Separate building controls contract from front end contract
- Impact
  - 20 new construction buildings in 2011
  - 6 “Dumpster Retrofits”
  - Ongoing for next 5-7 years
- Status
  - Directed by state engineers
  - Educated on needs, technology, and spec development
  - Enforcing state needs
  - Following LonMark Guidelines, Specs, Certifications

NTT DATA Shinagawa Building

- Scope
  - 3,459.07㎡ with 29 floors with three sub floors
  - Mixed use facilities
    - Offices
    - Restaurants
    - Retail stores
    - Branch shops
    - Conference facilities
- Application/Need
  - Open, integrated control system
  - Multiple view into system from GUIs
- Solution
  - IP Backbone
  - Integrated BMS, CCTV, access control
  - VOIP Communications
  - LONWORKS open architecture

Pfizer Pharmaceuticals

OVERVIEW:

- 37,000m2, four story Pfizer pharmaceutical research laboratory in Sandwich R&D facility
- Ove Arup & Partners were appointed by Pfizer Ltd to provide the engineering design services for the new building

SOLUTION:

- TAC/Schneider Electric –highly integrated job
- Uses open LONMARK solution for BMS for monitoring, metering, operational and supervisory control, trending, alarm handling and web browser functions.
- 2435 LONWORKS devices from over 15 different vendors
- Connected on over 60+ sub nets, backed by dual redundant IP network.
- 51,475 total points monitored

LONMARK® INTERNATIONAL

Roppongi Hills - Japan

OVERVIEW:

- World's largest stand-alone LONWORKS enabled building project with 759,100 m^2
- Four zones, 13 Buildings
  - Mori Tower; Four residential towers

SOLUTION:

- 16,500 LONWORKS devices primarily HVAC&R
- Over 170,000 points monitored
- Schneider IBMS with Citect front end
- Over 20% savings in energy costs over projection
- LONWORKS/IP integration using *i*.LON® servers
- Mori Building general developer/operator
  - Urban developer operating more than a hundred buildings
  - Extensive use of LONWORKS planned for world's tallest building – Shanghai World Financial Center

Singapore Management University

OVERVIEW:

- Installed state-of-the-art Intelligent Building Management System (IBMS)
- Multiple buildings
  - Class rooms
  - Dormitories
  - Offices
  - Restaurants
  - Conference facilities

SOLUTION:

- Integrated HVAC, lighting, access control, hot water
- Project 20% energy savings
- IP backbone
- LONWORKS open architecture

Coeur Defense Complex - France

- Building required a flexible, high tech, and open solution for its control-networking needs

- The Benefits
  - Cost-reductions
  - Flexibility
  - Easy changes and upgrades

- Products used in this project:
  - Desigo RXC21.1 fan-coil regulators – Siemens BT - Landis & Staefa Division
  - LRC 5048 8-way lighting controllers – Philips
  - 120 routers and 22 LNS servers - Echelon Corporation

Unitech - India

Overview:

- 5 buildings (80 000 m²) in different locations.
- Offices rented to various IT based companies
- HVAC : Chillers, AHU's, VAV Boxes.
- 2500 I/O : Power, UPS, Plumbing, Firefighting, Lifts, DG…

Customer needs:

- Flexibility
- Peer-to-peer communications
- Open technologies,
- Many remote I/O's … How to :
  - Reduce wiring costs
  - Enable automated sequences
  - Maintain flexibility & reprogramming
  - Maintain high speed communication

Solution:

- LON was the preferred technical solution :
  - Enable flexibility thru easy reconfiguration
  - Bindings technology allows for tying many remote I/O's in logical sequences, with reduced wiring costs
  - Open & evolutive
- BCU's on IP Backbone
- LONMARK MP 581, MP501/503
- Seamless integration

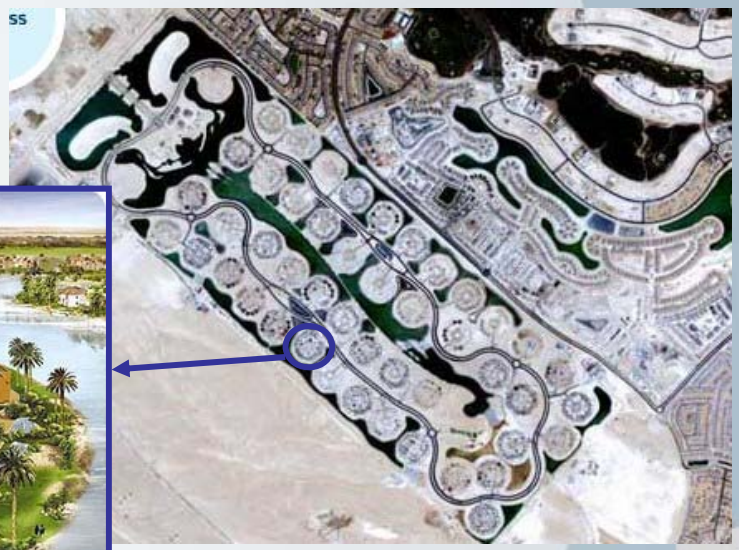
University of Miami Medical Campus

- $1.5M Clinical Research Building
- Completed Nov 2006, LEED Project
- 15-Story Medical Research Offices, Wellness Center, Parking Garage
- 20 AHUs, VAVs, Underfloor Air System, CHW Supplied from Campus CHW Loop
- UL864 Smoke Control, Fireman's Smoke Control Station, Siemens F/A System
- Douglas Lighting Controls, TAC LonWorks controllers, Viconics Thermostats
- User Interface handled on SI contract with UM Master Systems Integrator

Jumeirah Islands - UAE

Overview:

- District cooling for 1000 villas.
  Cooling capacity = 5 750 tons.
- Residential
- HVAC : Chillers
- Power

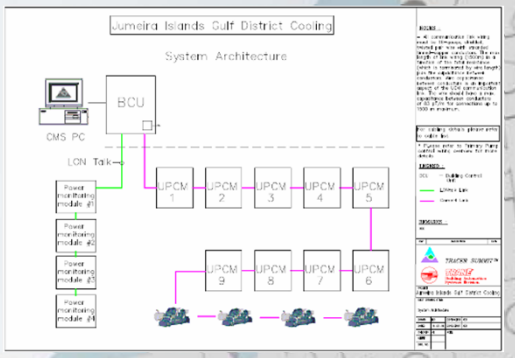


Customer needs:

- Energy Savings
- Energy monitoring
  (Current, Voltage, Power)
- Reliable communications
- Reduced I/O wiring

Solution:

- LON was selected :
  - Greater choice of power monitoring modules
  - Open & evolutive
- Direct integration of power metering module onto BCU
- Tracer Summit Chiller Plant Application



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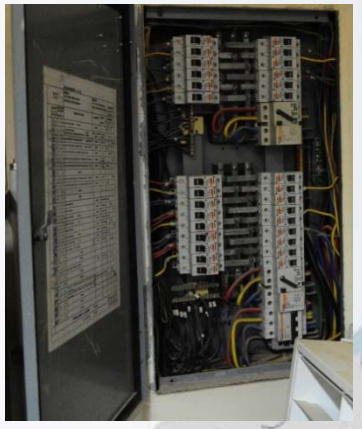
Kuwait Institute for Scientific Research

Kuwait Institute for Scientific Research

- Scope
  - Demand Response Control
  - Government – Ministry of Education and Ministry of Electricity
- Application/Need
  - Energy reduction control via Demand Response program
  - Open network platform
  - Flexible solution, multiple technologies integrated into common architecture
- Status
  - Pilot in 2008 - 8 Buildings
    - proof of concept phase completed ✓
  - Phase 2 - 2012 - **102 Schools**
    - 450 points/building
    - HVAC, Lighting, Power Meters, Solar
    - District Wide LON/LAN/WAN
  - Phase 3 - 3000+ buildings
    - Mosques, Schools,
    - Government, Homes

120 Split Units

5 Power Panel Sub-meters



15 Lighting Panels

10 Packaged Units

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Workshop Discussion Question #4

What are your key learnings today and your next steps?

Total Facility Control

Results of Prior Workshops

- I can get an open system, I just have to demand it
- Integration of my systems into one control system is needed to be more efficient, save costs, and improve energy usage
- We need a good master plan for our facilities
- Open systems provide advantages we need to implement
- Help is available and there are solutions that we need to investigate
- Others have successfully implemented an open solution, we should too

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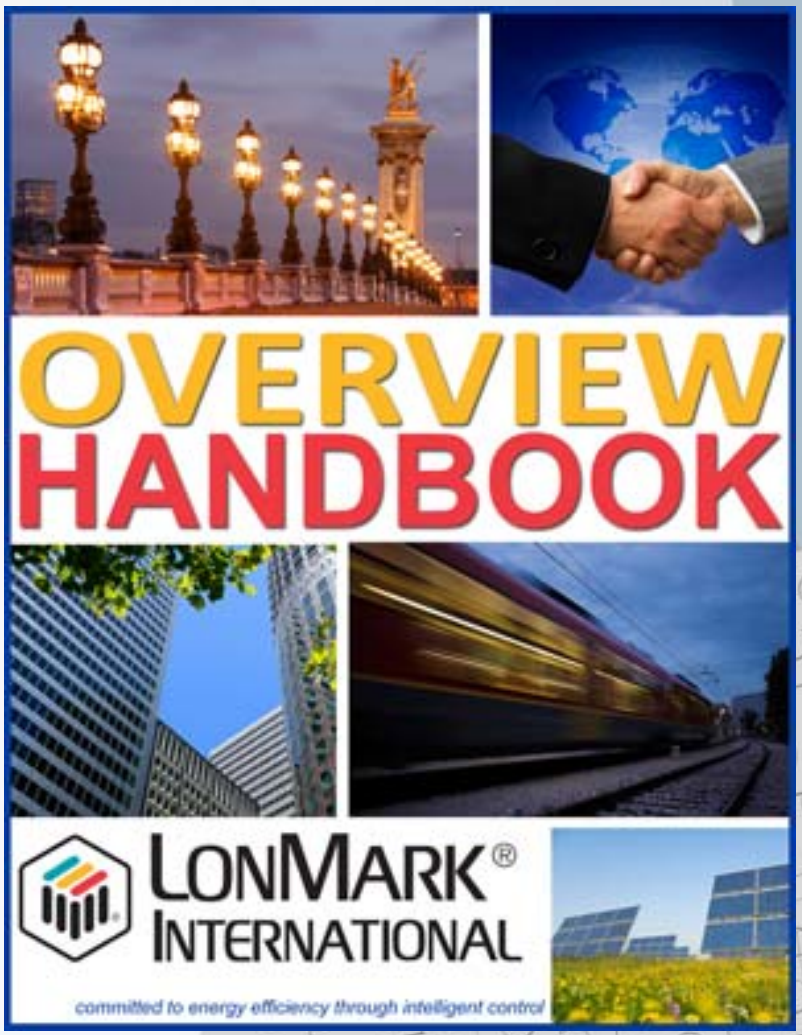
LONMARK Programs And Resources

LONMARK Overview Document

- Compilation of all ‘about’ documents
- Available
  - Marketing-in-a-Box CD
  - Information CD
  - Printed copy
  - PDF

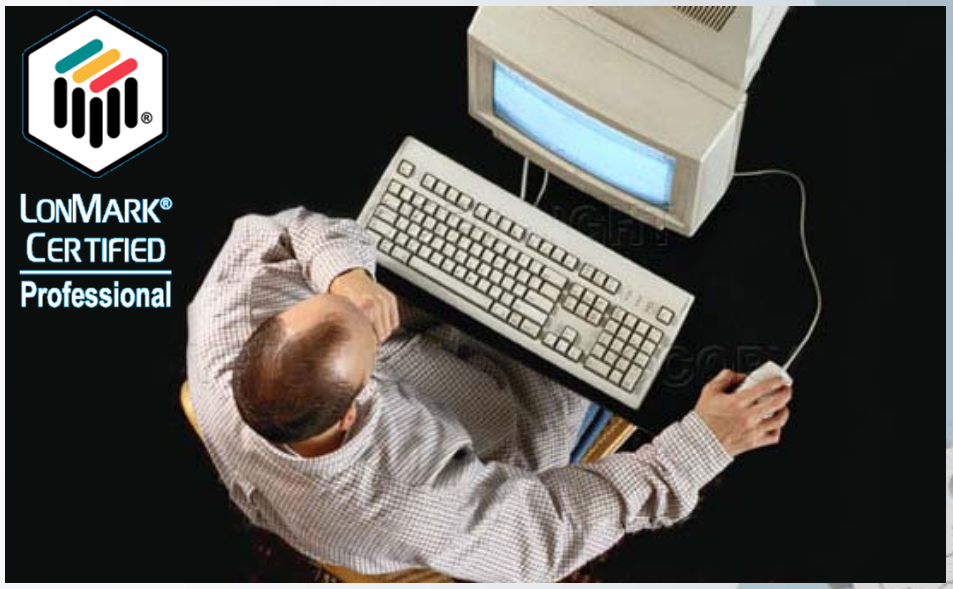


http://www.lonmark.org/about/docs/LonMark_Overview%20Ver4%20May%202009.pdf

LONMARK® INTERNATIONAL

Integrator Training, Testing, Certification Programs

- Programs to deliver a comprehensive professional testing and certification
- Worldwide standard of proficiency
- Web-based exam
- Professional, Integrator, and Expert Credentialing
- www.lonmark.org/testing



LonMark Training

- LMI Training Classes
  - LonMark Professional Certification one day refresher class
    - Followed by testing
    - Available now
    - Contact LMI to schedule local class/test
  - Custom Onsite “Project Specific” training
    - Available now
    - Flexible Agenda – Basics to Advance – Project Guidance
    - Fee based (time and expenses)
  - Online web based interactive training (in development)
    - LON basics and advanced modules
    - Compliment the testing program
    - Sneak Preview of First Module
  - See www.lonmark.org/training

LONMARK Credentialing Programs

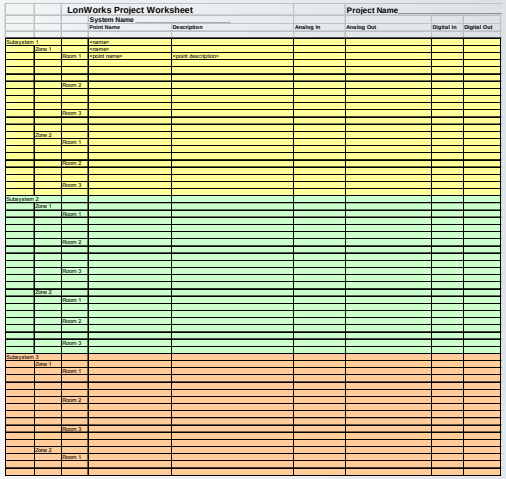
- **LONMARK Certified Professionals (individuals)**
  - Comprehensive testing program for engineers, installers, integrators
  - Over 400 LonMark Certified Professionals
    - http://www.lonmark.org/certifications/professional_certification/
    - Available Languages
    - English, German, Spanish – Available Now
    - Japanese (in 2013)
  - Recertification process (every 3 years)
    - Includes Online Training and Test
    - Ongoing training and education
  - Meets specification requirements for professional proficiency

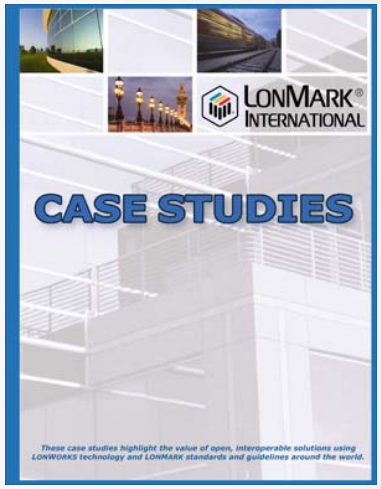
LONMARK Credentialing Programs

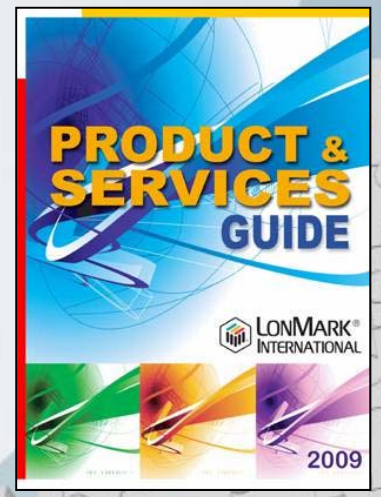
- **LONMARK Certified System Integrator (companies)**
  - Proven proficiency and commitment
  - Employ LM Certified Professionals
  - Strong training and field experience
  - Prior successful projects
  - Peer-review panel
- Establishes high level of proficiency
- Benefits owners/contractors
- Ensures contractor qualification are met

Specs, Tools, and Resources

- Sample Specifications
  - LonMark Master System Specification
  - Army Corps Specification
  - Army Corps document library
  - Functional and Performance Open Spec - NEW 2010
- Tools
  - Sample Point Schedule Template
- Resources
  - Product and Services Guide
  - Case Studies
  - Product Database
  - Certified Professional Directory

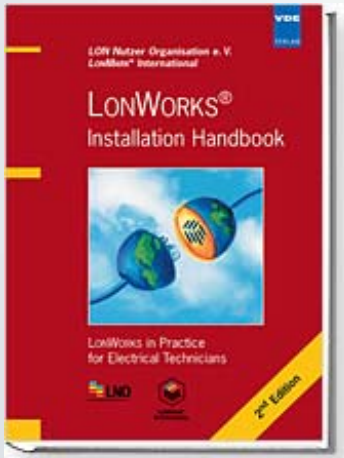


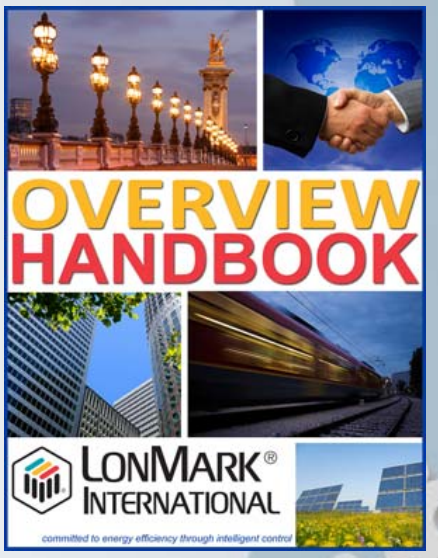


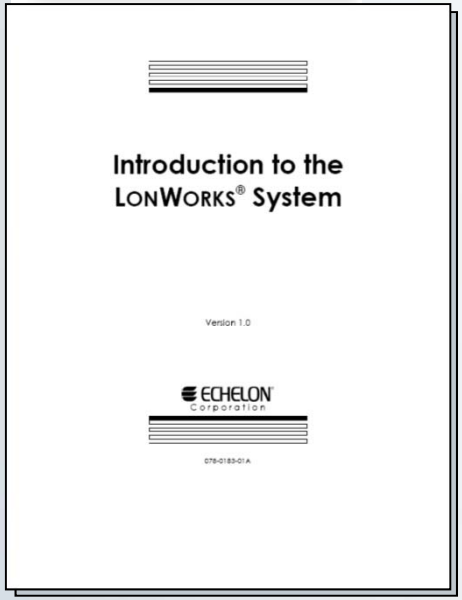


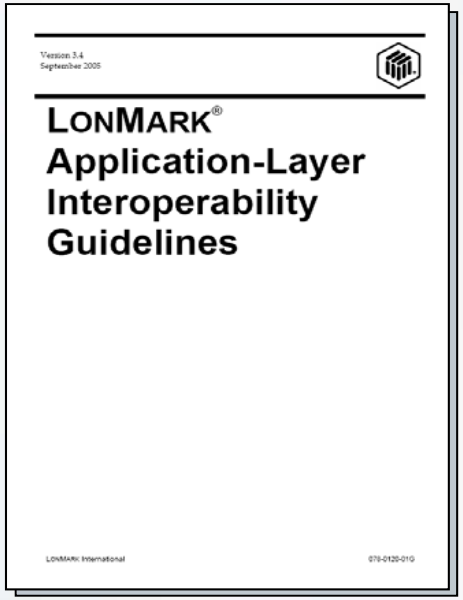
Additional Resources

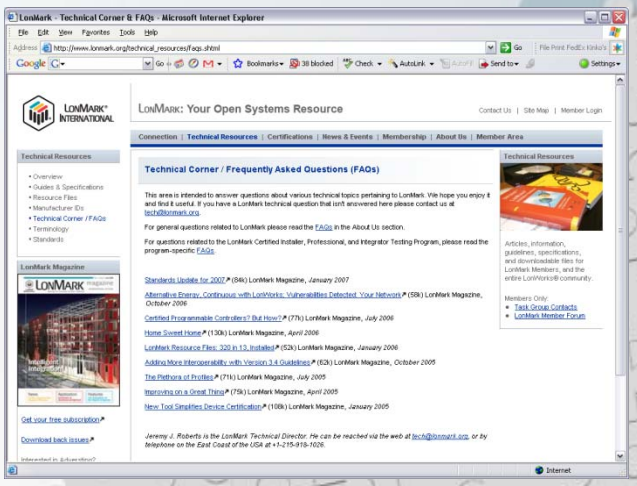
- The LonWorks Installation Handbook
- Overview of LonWorks
- LonMark Interoperability Guidelines
- Training and Certification
- www.lonmark.org











LONMARK Helps Large Customers

- Helping Develop Open Specifications
  - LONMARK Training for Writing Good Open Specs
  - Educational Seminars
- Facilitating Vision Setting With Project Teams
  - Green Energy Efficiency Programs
- Help with Master Planning
  - Unified System Architecture Support
- Support for Open Bidding
  - Qualified System Integrators
  - Certified Interoperable Products
- Resources
  - Master Specification Examples
  - Case Studies, Research

LONMARK Helps Large Customers

- LONMARK Specifications – Large Projects
  - New York City Schools
  - US Military - Americas
  - City of San Jose, CA
  - McDonalds - Worldwide
  - GSA - America
  - NASA, FL
  - Military Base; Okinawa, Japan
  - Kuwait Demand Response Project
  - City of Masdar, MIST, UAE
  - Columbus Regional Hospital, IN
  - And many more…

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Summary

- Demand is growing for good open specifications
- Help is available to deliver more open solutions
- We are committed to
  - Expanding the market for Open Systems and certified products
  - Enhancing the standards as technology advances
  - Increasing the number of certified products
  - Supporting Owners, Integrators, Vendors
- Develop new programs, resources, and tools
- Focus on Education, Training, Certification

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Questions

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Additional Topics and Backup Slides

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Workshop Agenda

- Introduction to Energy Efficiency Through Intelligent Controls
- The Trend Towards Open, Integrated Control Systems
- The Elements of an Open Controls Platform
- Introducing LON – Local Operating Networks
- Specification Development Requirements
- The Changing Contractor World
- Introducing the Two-Tier BMS Spec
- Use Case Examples
- Tools, Resources, and References

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Introducing LON Local Operating Networks

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What is LonWorks

- LON – Local Operating Network
  - A open platform for interoperable controls
  - Designed specific for control communications
  - High speed, high reliability
  - Short messages for control
  - Thousands of devices in a peer-to-peer network
  - Standards data types, device profiles
  - Worldwide platform adoption

LON®, LONWORKS®, and LONMARK®

- **LonTalk®**
- **ANSI/CEA-709.1-B**
- **ISO/IEC 14908-1,2,3,4**
- **LONWORKS®**
- **LON**

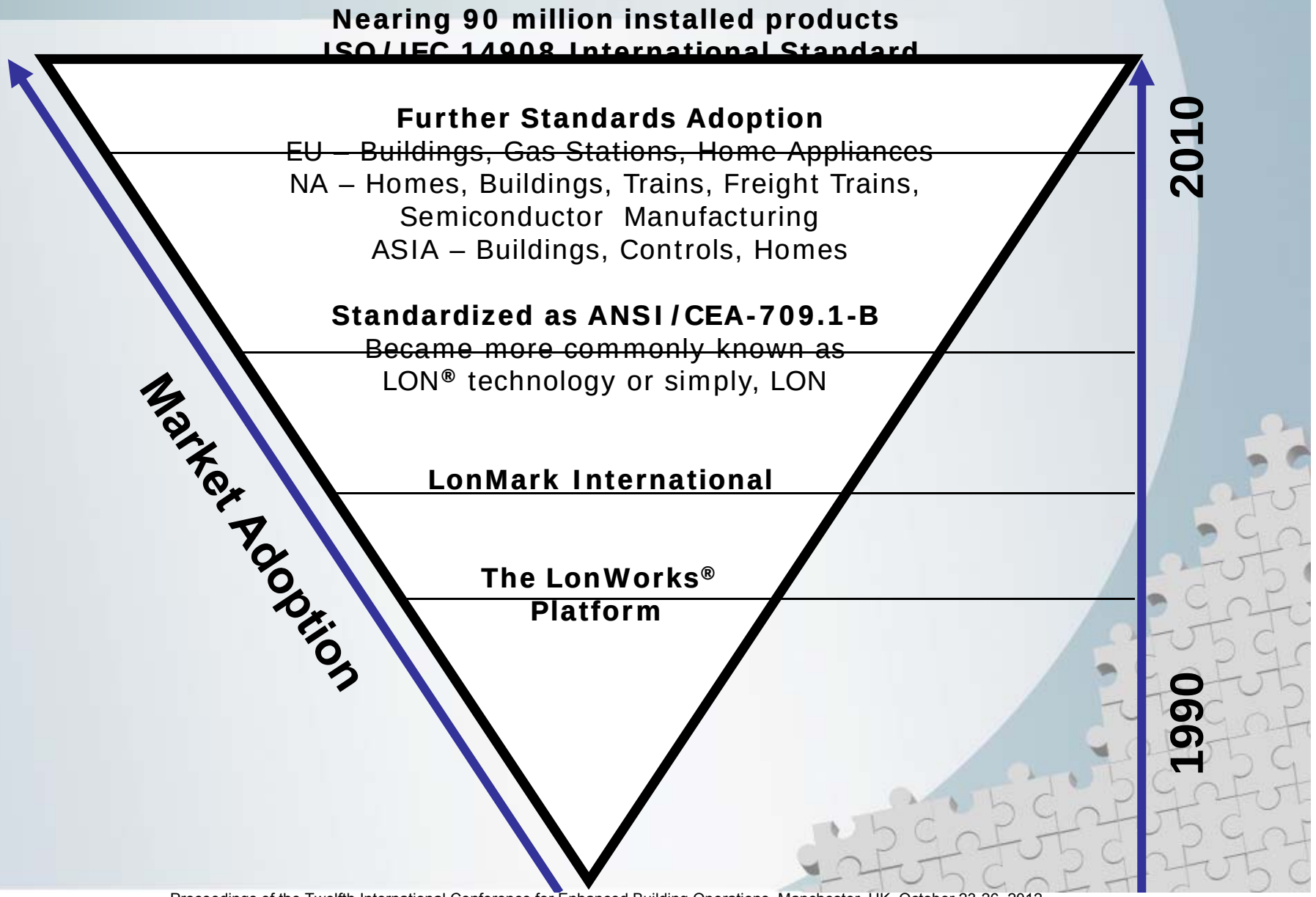
- **Echelon Corporation's trade name for the ANSI/CEA-709.1-B protocol**
- **The ANSI standard name for the communications protocol underlying LONWORKS networks**
- **ISO international standards for LonWorks**
- **Products and applications based on LON technology. Also, a description of products that use the Neuron® microprocessor, *e.g.*, "a LONWORKS valve controller"**
- **"Local Operating Network" – the most-common way of referring to a device, network, or application based on LONWORKS**

LONMARK: The Organization & The Mark

- LONMARK®
  - International
  - Logo

- Brand of Recognition:
  1. Organization of ~400, worldwide, member companies dedicated to advancing LONWORKS technology
  2. “The Mark”

History of LON – Adoption / Time



Benefits of Energy Efficient Controls

- Open Integrated Systems Goals
  - Lower Install Costs
  - Lower Life Cycle Costs
  - Lower Energy Costs
  - Greater Performance
  - Improved Occupant Comfort
  - Reduced Operation and Maintenance Costs
  - Smarter Systems
  - Lower Risk, Higher Security

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Project Types

- Design/Build
  - Private sector
  - Negotiated contract
  - Single project
  - Engineered system
  - Heavy reliance on contractors
- Plan/Spec
  - Public sector
  - Fair competitive bidding
  - Multiple projects over time
  - Need for master plan
  - Need for project coordination

Specification Types

- Single Premise
  - One building
  - One contractor team
    - General
    - Mechanical
    - Controls
  - One system architecture
    - Minimal integration
  - One GUI
    - Local access only
- Campus/Enterprise
  - Multiple buildings
  - Multiple contractors
    - Multiple Generals
    - Multiple Mechanicals
    - Multiple Controls
  - Multiple system architectures
    - Massive integration
  - Multiple GUIs or one common GUI for all projects
  - Local, remote, enterprise access to data

LONMARK® INTERNATIONAL

Introducing LONMARK International

LONMARK International

- Independent, non-profit worldwide member supported organization
  - Product Manufacturers
  - System Integrators
  - Engineers
  - End Users
- Vision
  - LONMARK is the recognized industry authority for certification, education, and promotion of interoperable standards for the benefit of manufacturers, integrators, and end users

LONMARK Devices Guarantee Interoperability

- LONMARK International
  - Independent Industry Association
  - Established in 1994
  - Task groups focus on specific industry requirements
  - Define device SNVTs, Objects, Profiles, IP connectivity
- What we provide
  - Interoperability design guidelines
  - Product conformance testing
  - Professional testing
  - Marketing assistance
- LONMARK Stamp of Approval Means Devices Will Interoperate

LONMARK® INTERNATIONAL

The LON Protocol
An International Standard

ISO/IEC 14908

ANSI/CEA-709.1-B

EN 14908-1:2005

GB/Z 20177.1-2006

IEEE 1473-L

Proceedings of the Twelfth International Conference for Enhanced Building Operations, Manchester, UK, October 23-26, 2012

LONMARK® INTERNATIONAL

Members Around the World

- ≈400 member strong independent, non-profit standards organization
  - Product Manufacturers
  - System Integrators
  - End Users

LONMARK International Standards and Program Offerings

- Manufacturers
  - Interoperability guidelines
  - International standards body adoption
  - Product design support
  - Certification of interoperability
  - Promotion and adoptions support
- Integrators
  - Training and education programs
  - Proficiency and credentialing
  - Product resources
  - Integration resources
- End-users, Owners, Specifiers
  - Specifications examples
  - Project support
  - Interoperability and open systems support
  - Qualified vendors, professionals, and integrators

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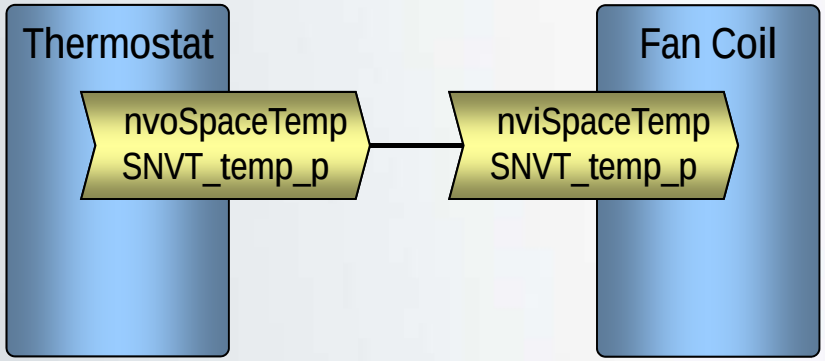
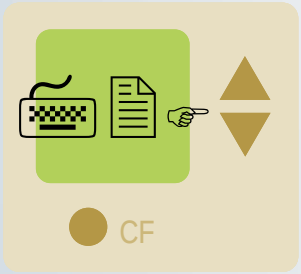
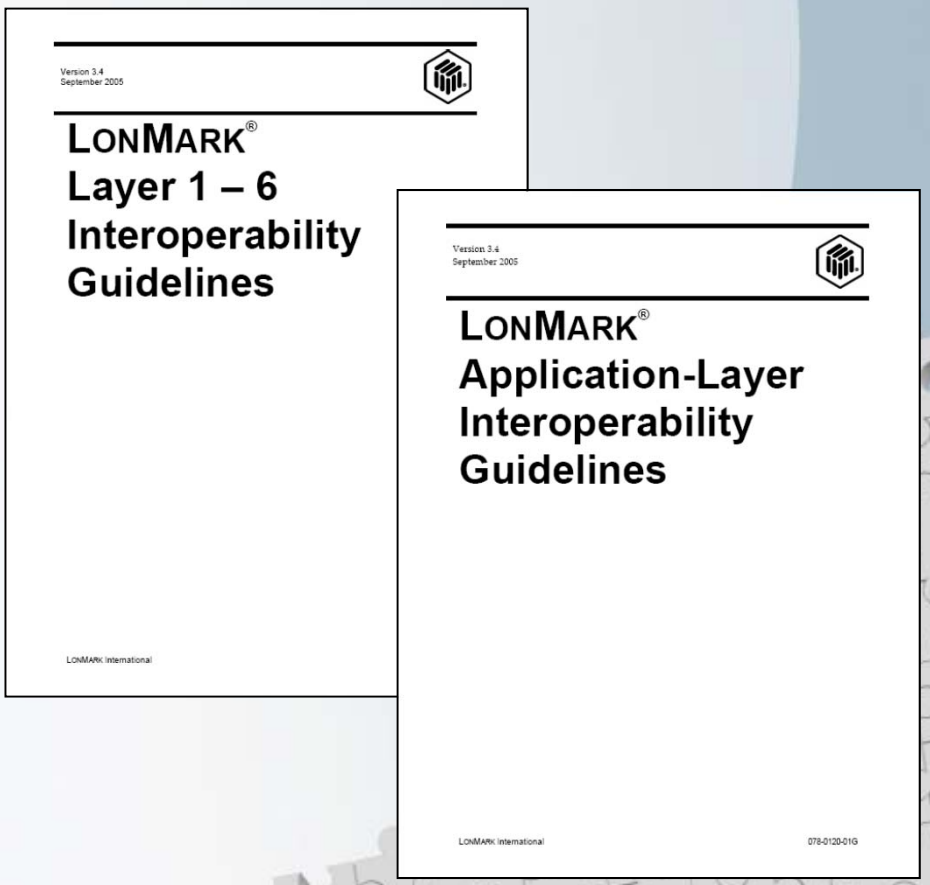
LONMARK Interoperability with Network Variables





Standard Network Variable Type



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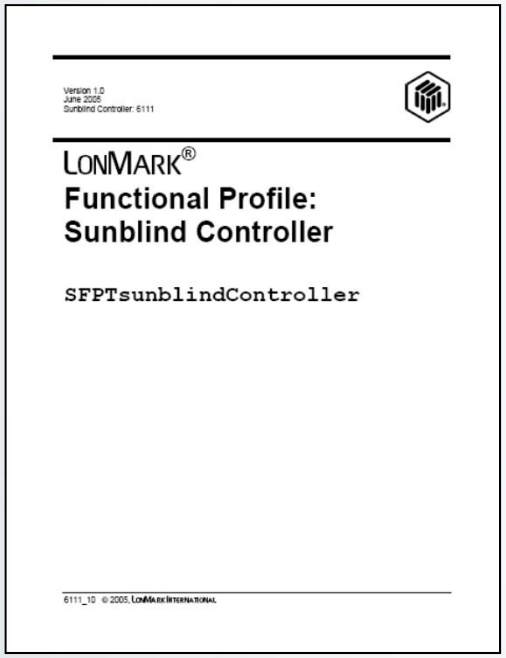
LONMARK Functional Profiles

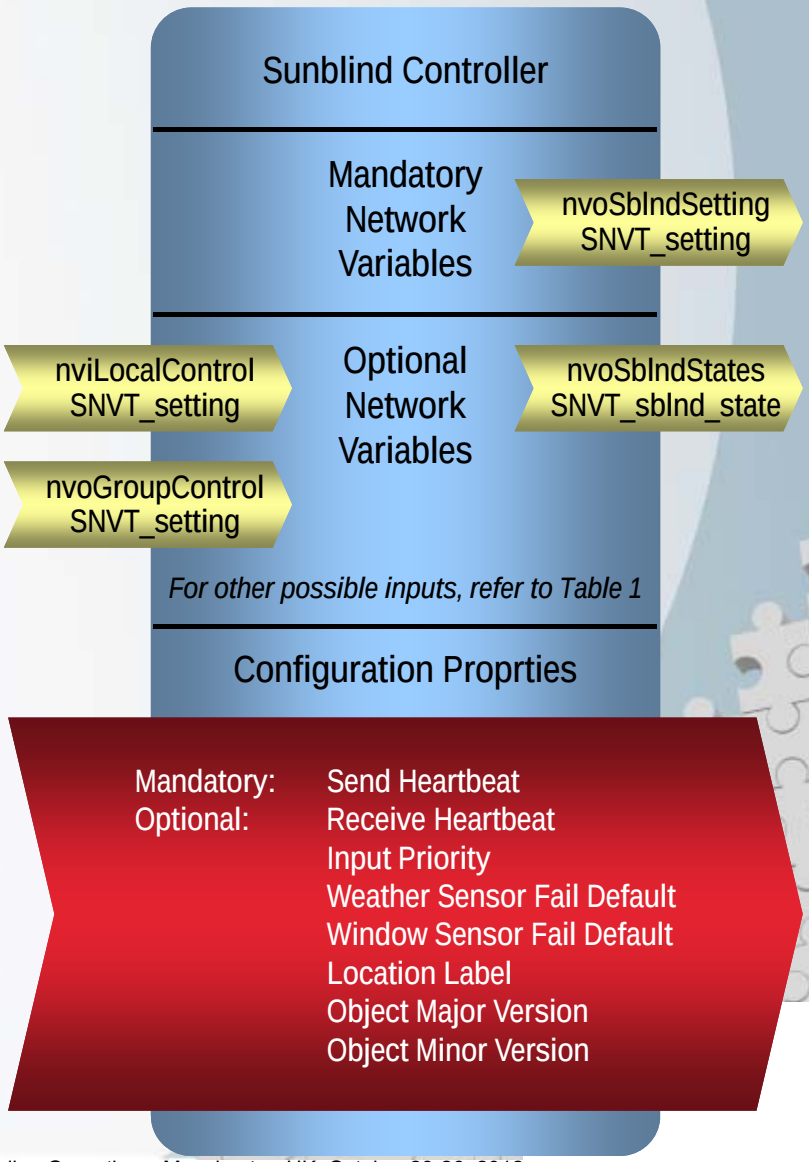


Version 1.0
June 2005
Sunblind Controller: 6111

LONMARK®
Functional Profile:
Sunblind Controller

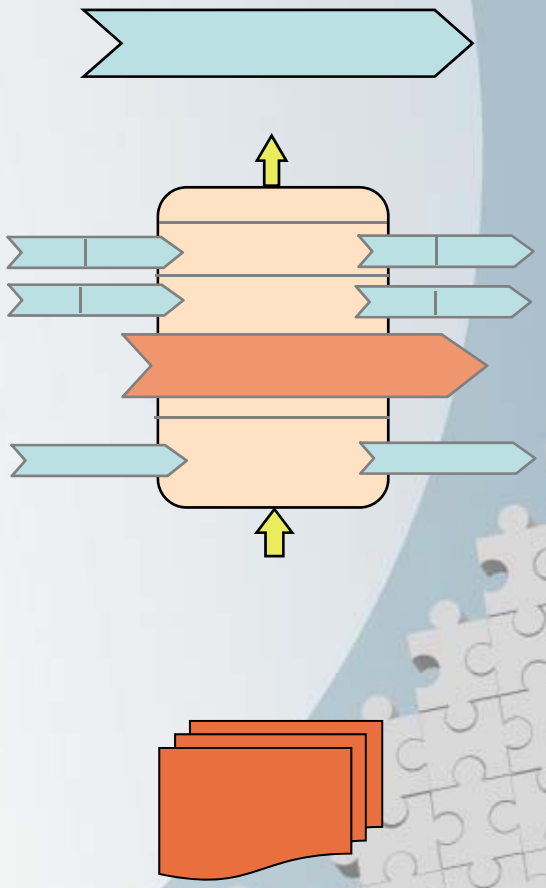
`SFPTsunblindController`

6111_10 © 2005, LONMARK INTERNATIONAL



LONMARK Interoperability Guidelines

- Data interpretation
  - Standard representation of data types
- Standardized functional behavior of a nodes
  - LONMARK objects
  - encapsulated network interaction of defined functions
- Standardized support of smooth and trouble free installation
  - Self documentation of a network oriented external interface
  - Guidelines for Network Management

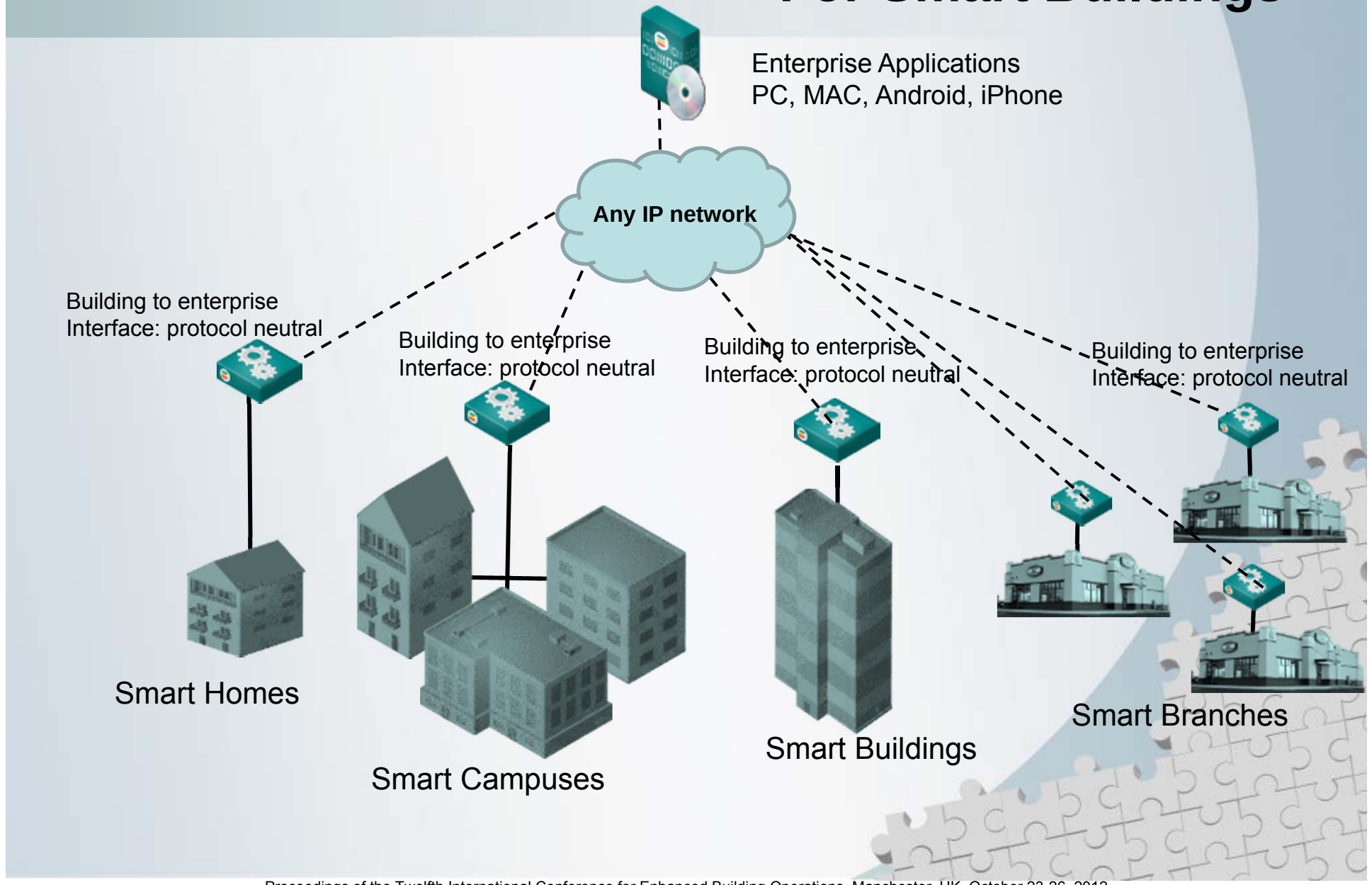


LONMARK® INTERNATIONAL

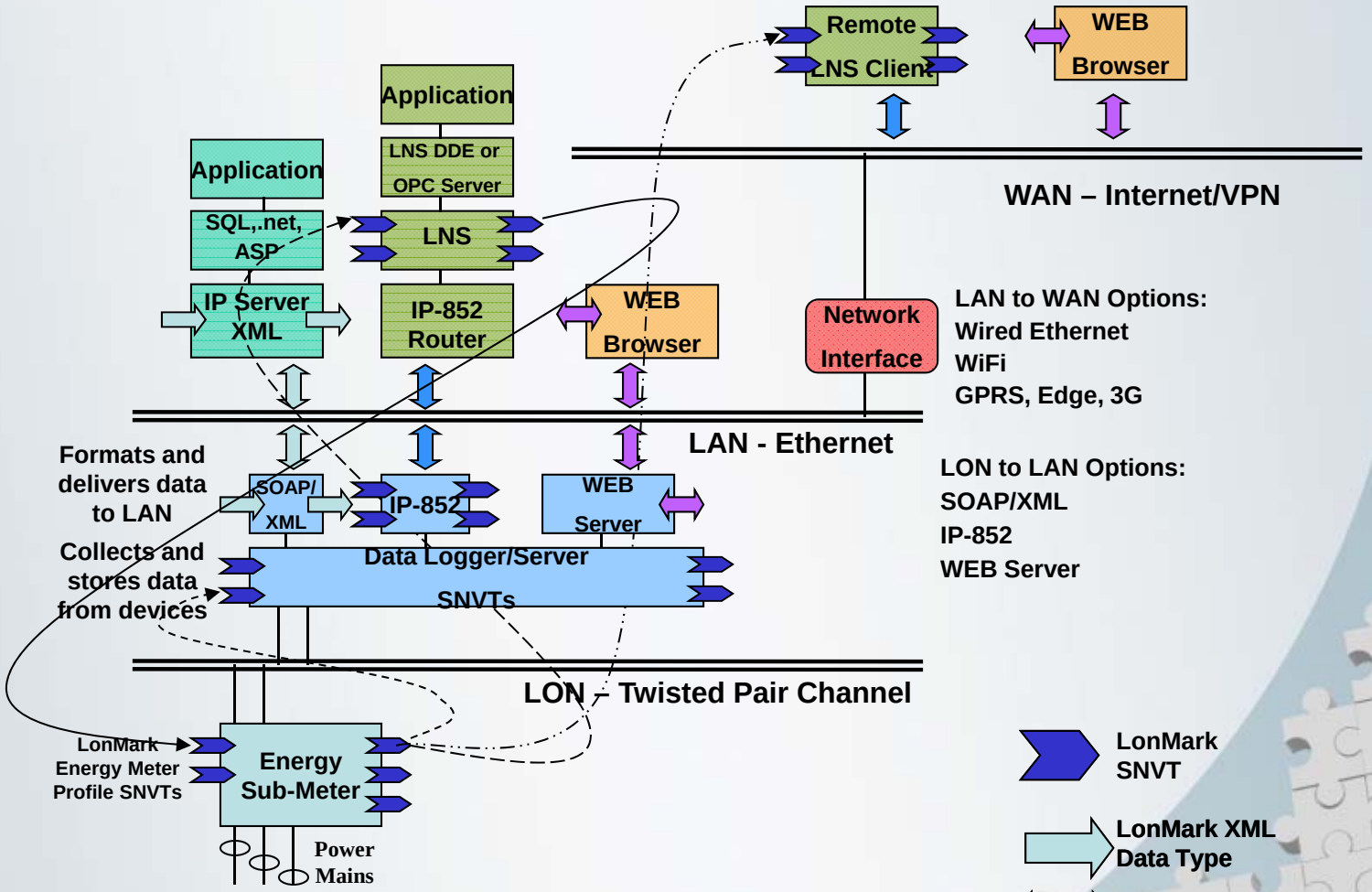
The Stats

- ~500 Certified interoperable products
- >400 Certified professionals
- >90 LonMark standard profiles
- ~90 Million installed LonWorks devices
- ~300-400K LonWorks systems installed
- ~400 LonMark International members worldwide
- 13 LonMark International Affiliate organizations around the world

Control Networking Platform
For Smart Buildings

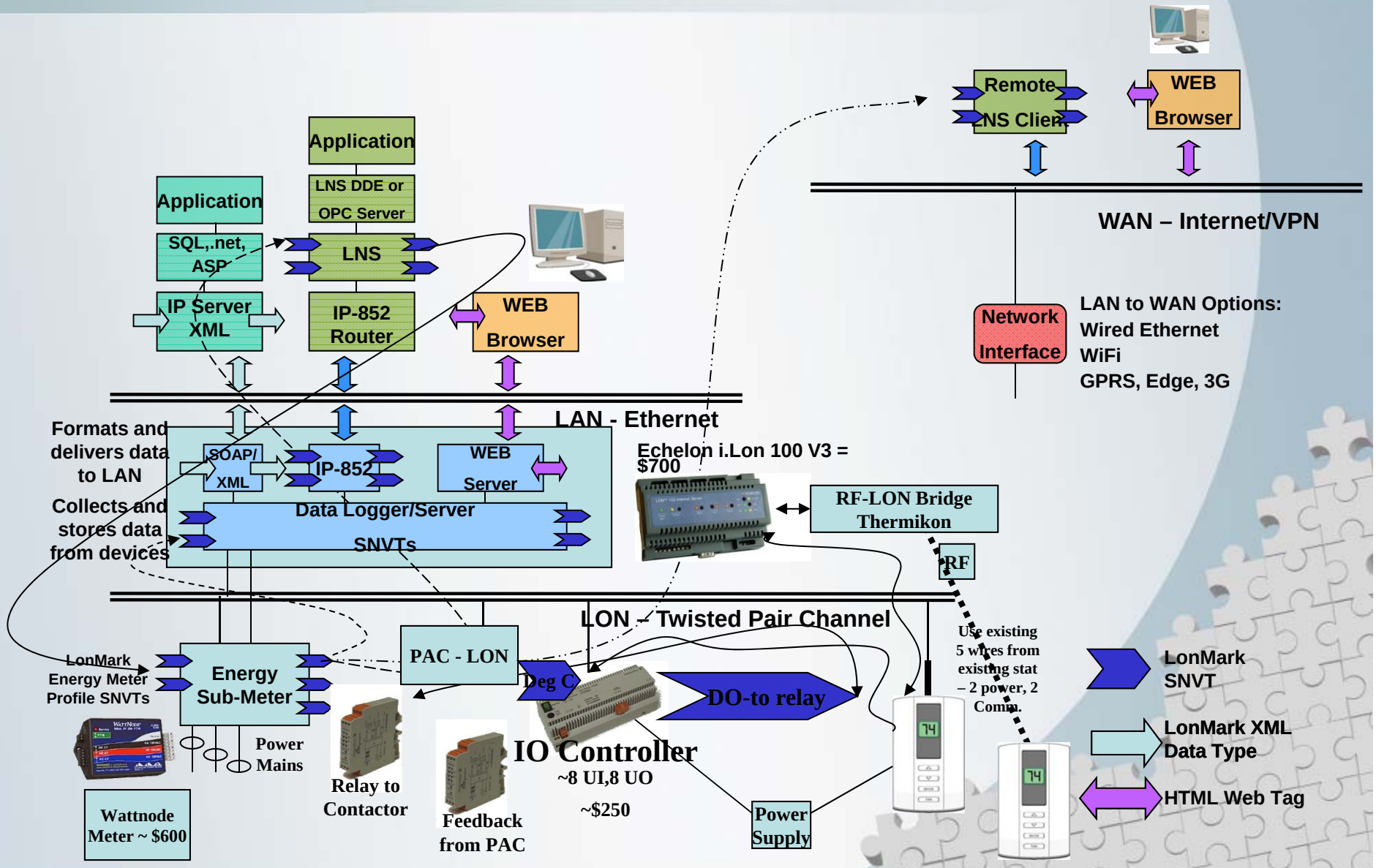


System Architecture

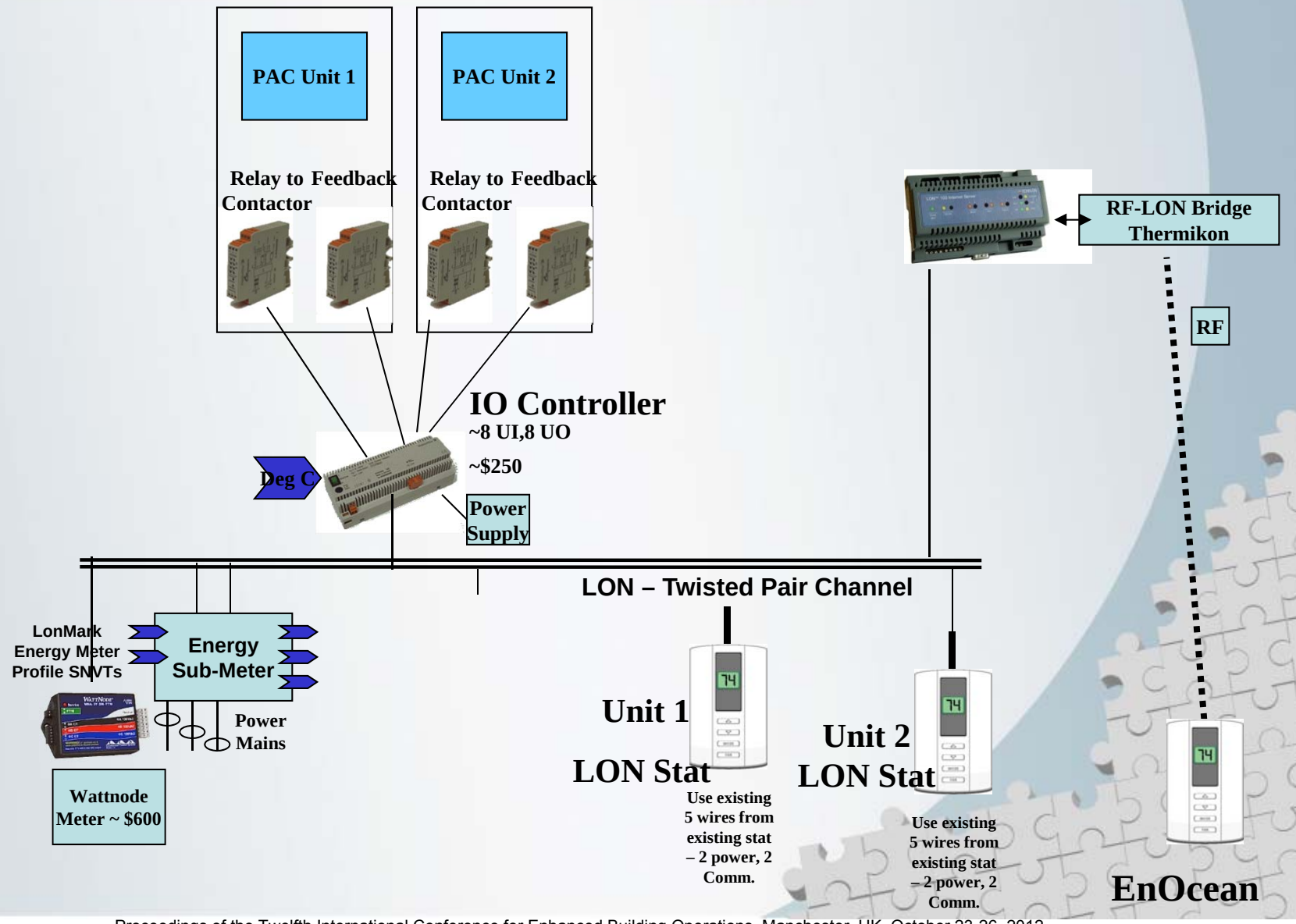


LONMARK® INTERNATIONAL

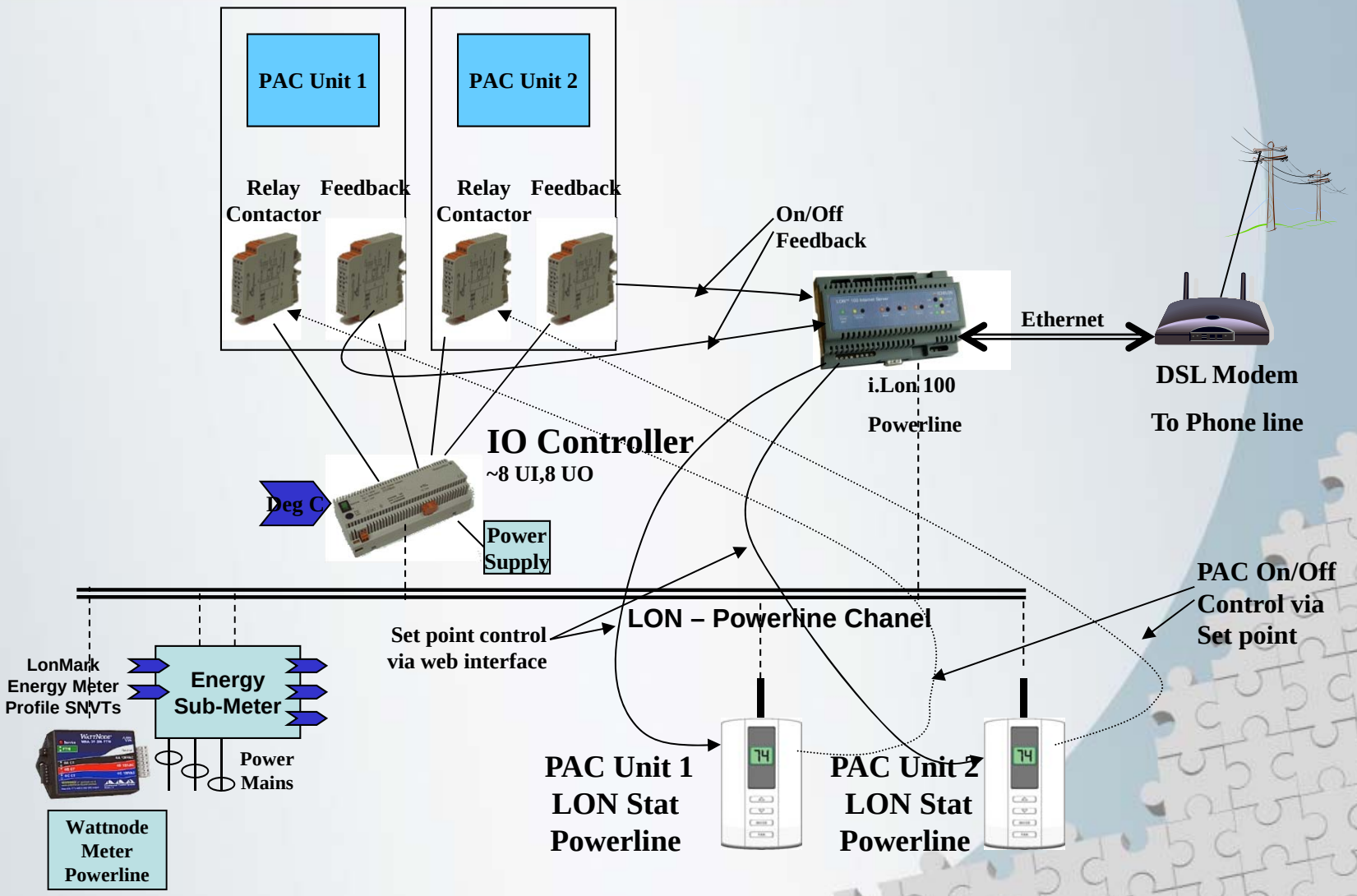
System Architecture



Option #1 - Twisted Pair/RF



Option #2 - Powerline



Hardware Costs (w/Install)
Total ~ $6000/site

IO Controller Powerline– 8 UI, 8UI - $350

WattNode Power Sub-meter - $700

i.Lon 100 e3 - $700

Powerline Thermostat - $300

Contactors (Relay – 2/PAC) - $50 per PAC X 10 PAC ~ $500

Software

- Web Programming –
  - Create HTML/XML interface software
  - Use i.Lon Vision and Contribute (Adobe)
- IT Support
  - Need Static IP address for i.Lon 100
  - Need IP Address for Web Server PC
- Hardware/Software on Server PC
  - Graphics development, data server interface

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Communication

- WAN connection to each building site
  - Provides access to enterprise server and User Interface
- Option 1
  - DSL line to each building
    - Preferable option
    - Cost effective, easy to maintain
- Option 2
  - GPRS
    - Less desirable
    - More costly, more complex

Software GUI – Coming from Central Server

Software GUI – Coming from i.Lon in 1 building

Bldg 4

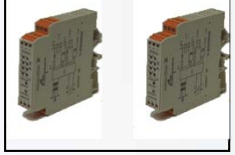
Total Current Usage – 6,600 MW

PAC Unit 1

PAC Unit 2

Relay to Feedback Contactor

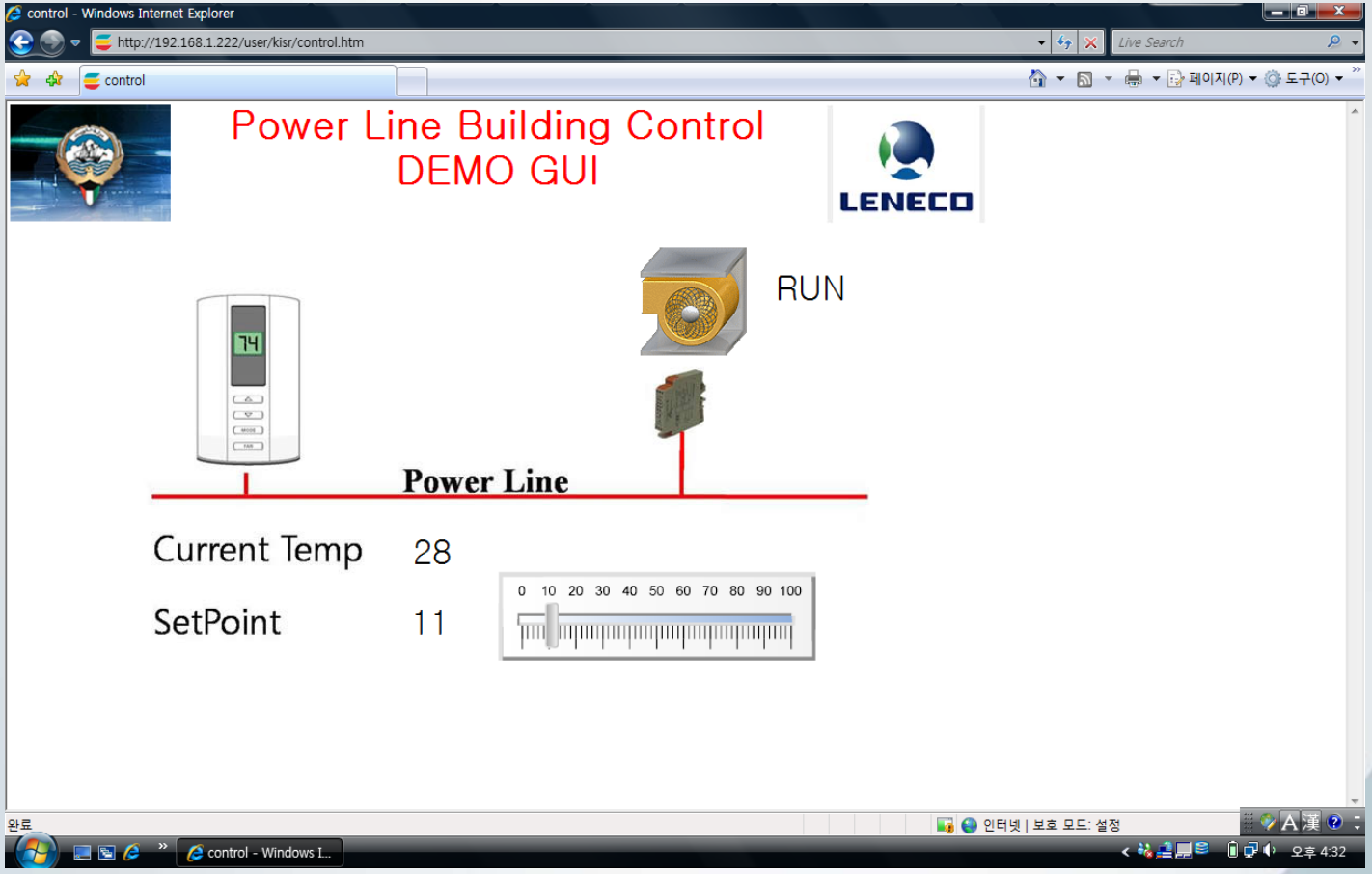
Relay to Feedback Contactor



Set Point = 21

Current Temp = 19.5

Demo GUI


control - Windows Internet Explorer
http://192.168.1.222/user/kisr/control.htm
Live Search
control
Power Line Building Control
DEMO GUI
LENECO
RUN
74
Power Line
Current Temp 28
SetPoint 11
0 10 20 30 40 50 60 70 80 90 100
완료
인터넷 | 보호 모드: 설정
control - Windows I...
오후 4:32

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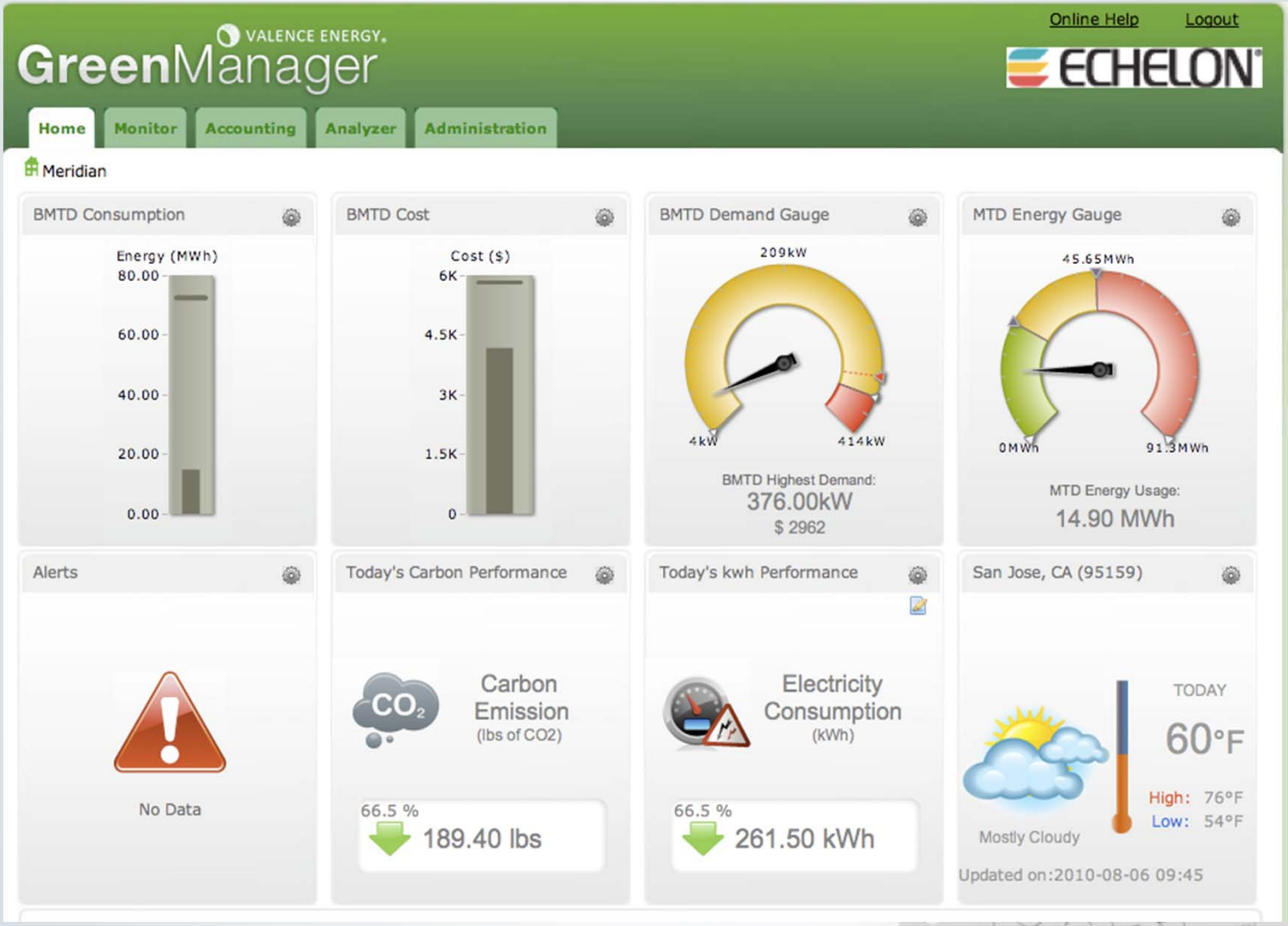
User Interface Examples



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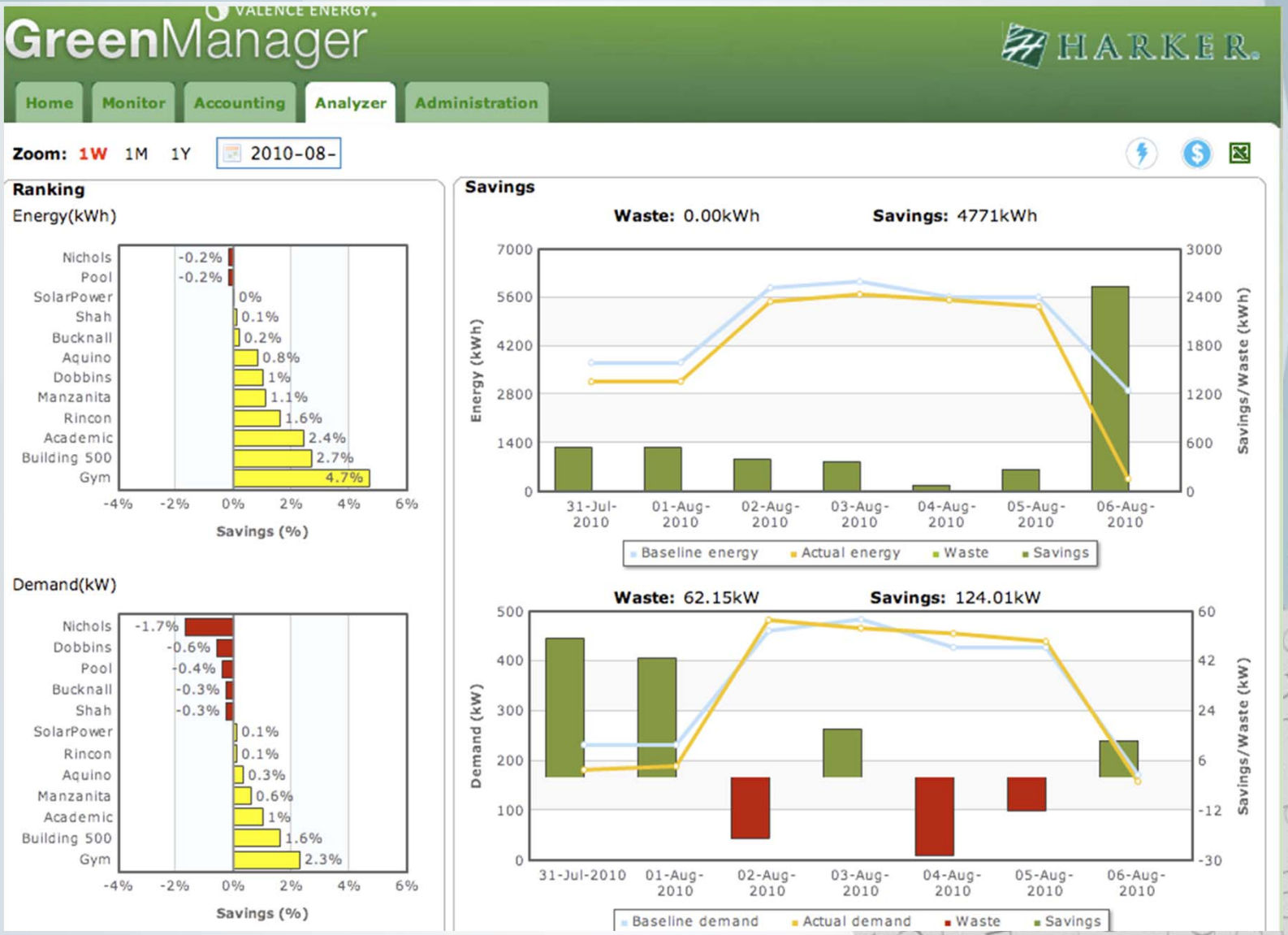
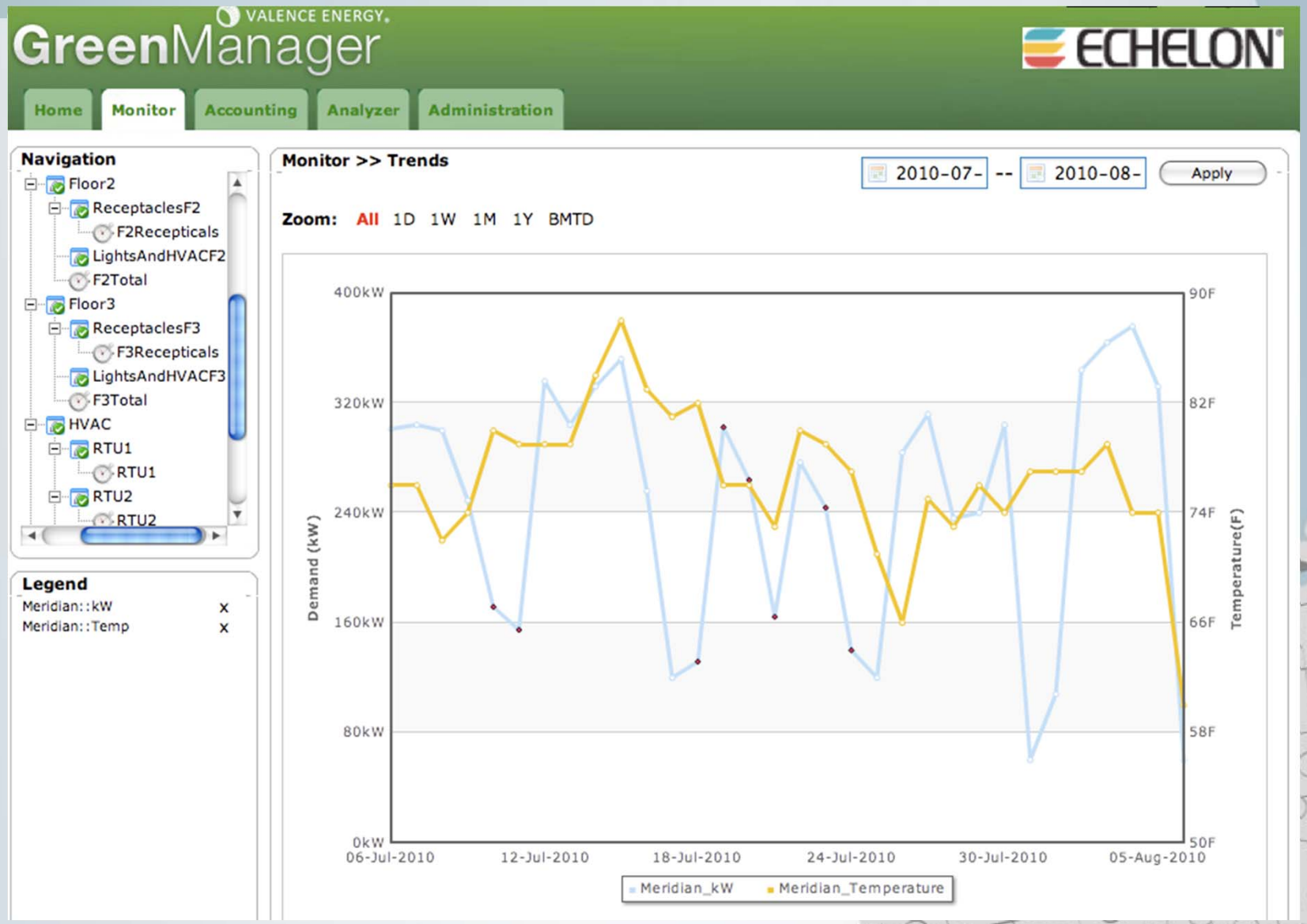
User Interface Examples



User Interface Examples



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User Interface Examples

Building : All Campus

Rankings

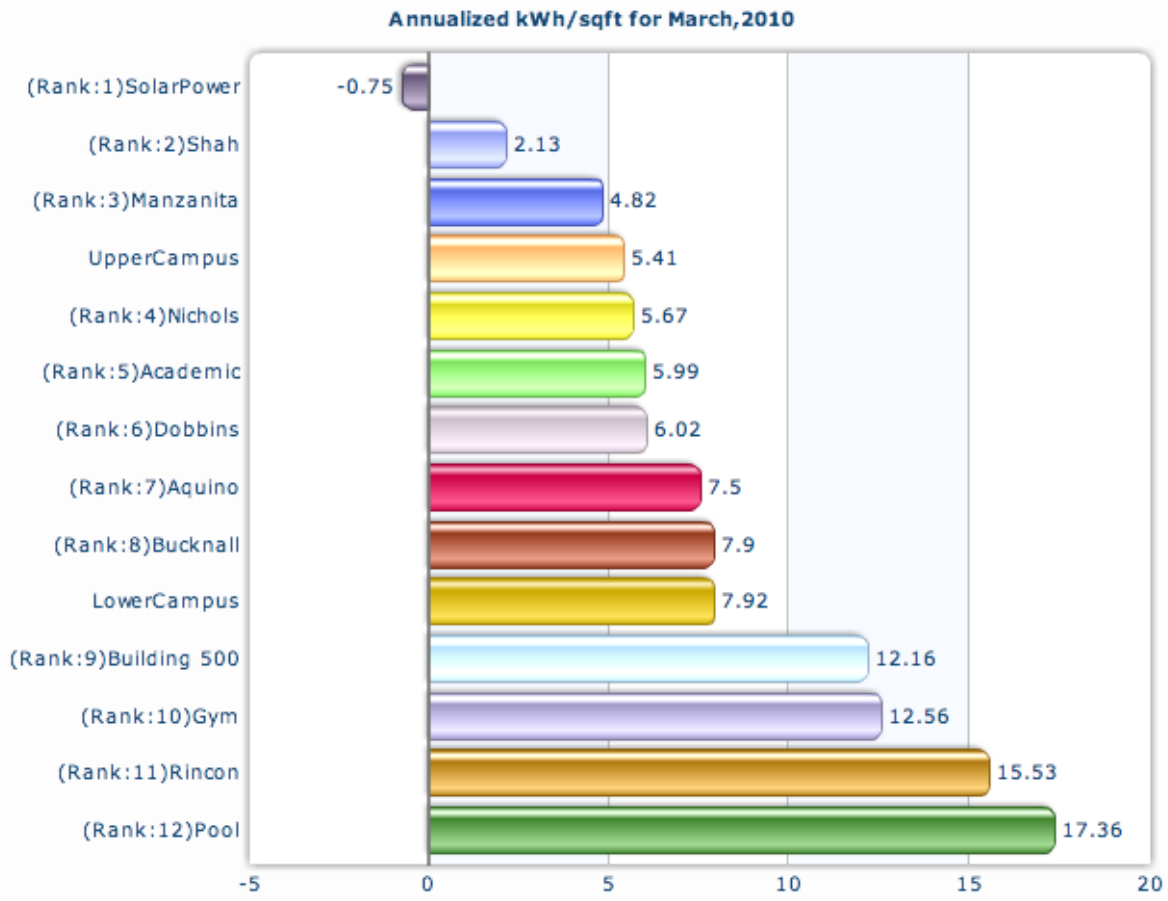
$/sqft : N/A

kWh/student : N/A

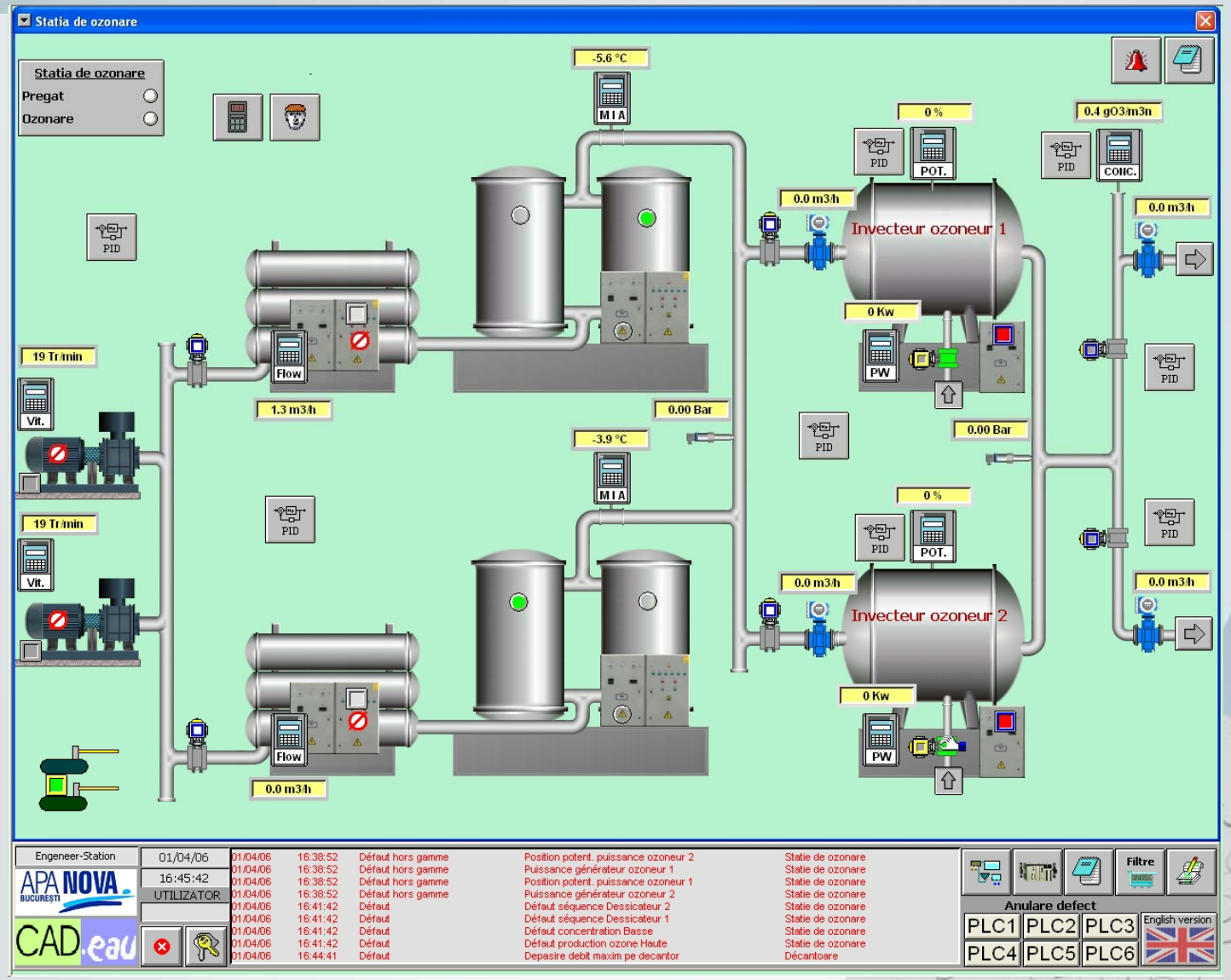
Reduction : 3rd

Total savings : 8%
Total consumed : 135 MWh
Avg MWh/yr : 101 MWh

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec



User Interface Examples



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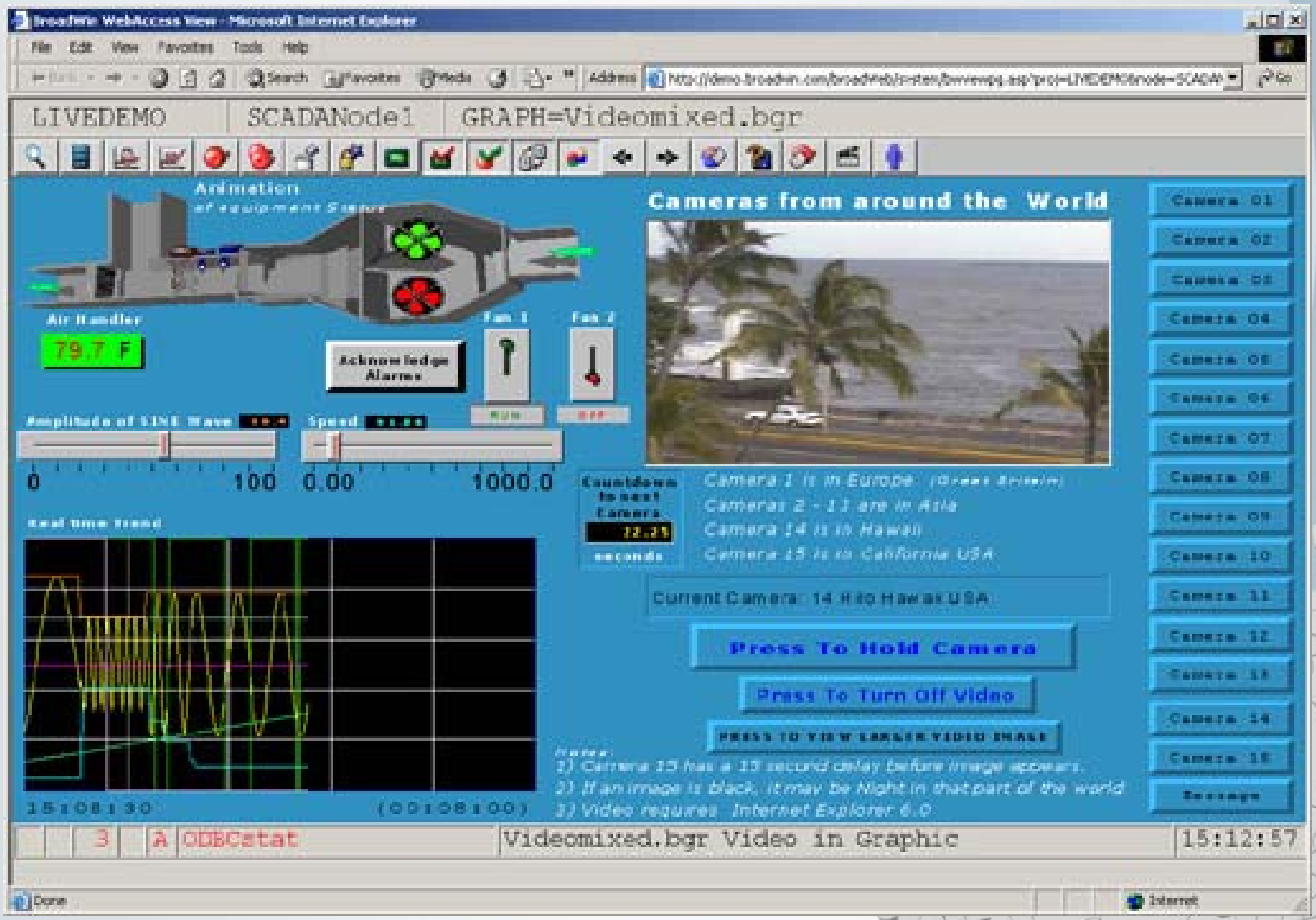
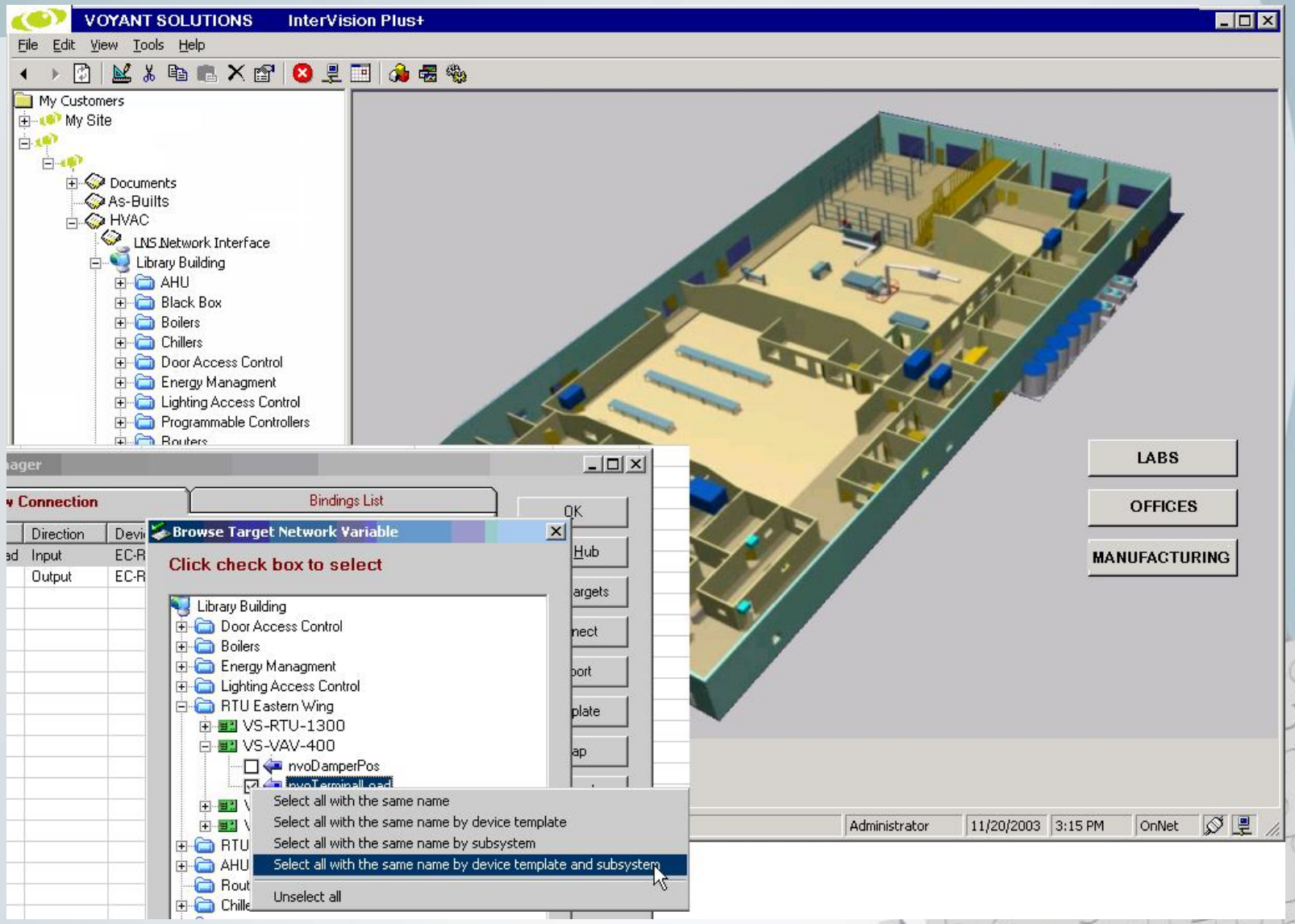
User Interface Examples



User Interface Examples



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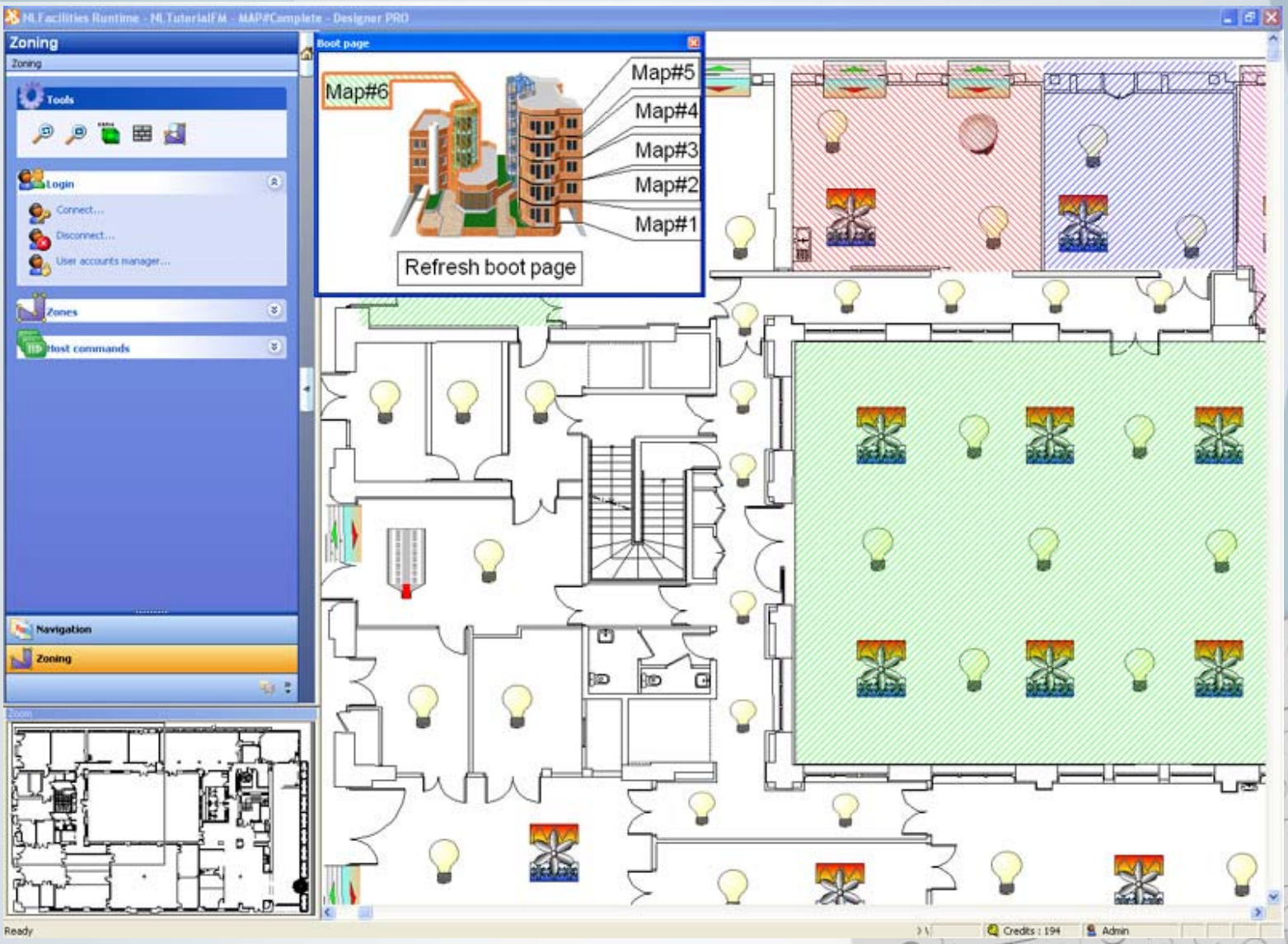
User Interface Examples



Common Elements

- Web or IT based interface
- Open solution
- Software GUI not “Tied” to hardware
- Dashboard options
  - Pick and choose needed options
  - Not overloaded with data
  - WYSIWYNTS – What you see is what you need to see!
    - Nothing More, Nothing Less
- Variety of vendors
  - Follows “APS” model

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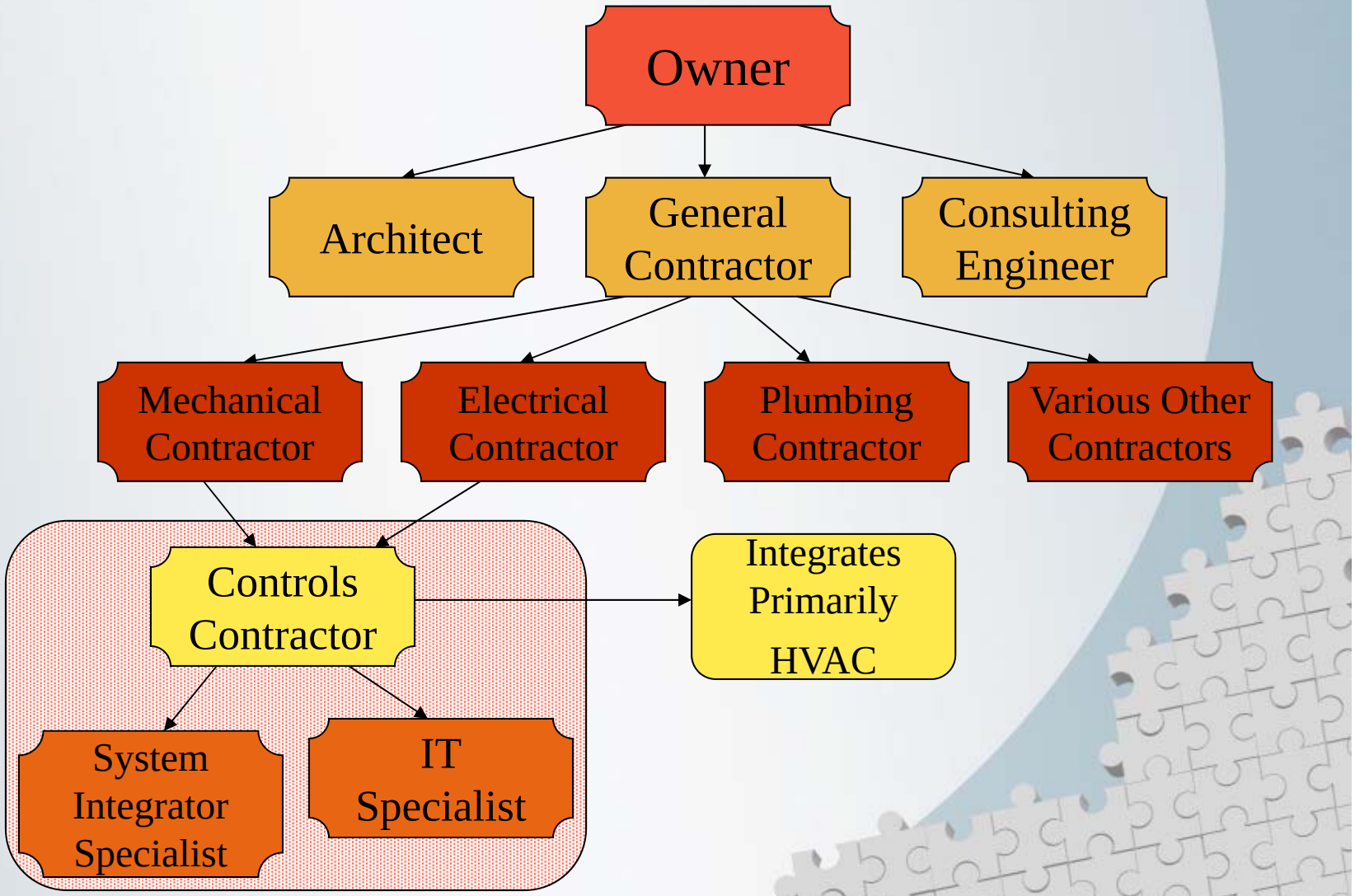
The Changing Contracting World

Traditional Contractor World Today
Single Building Project – Minimal System Integration



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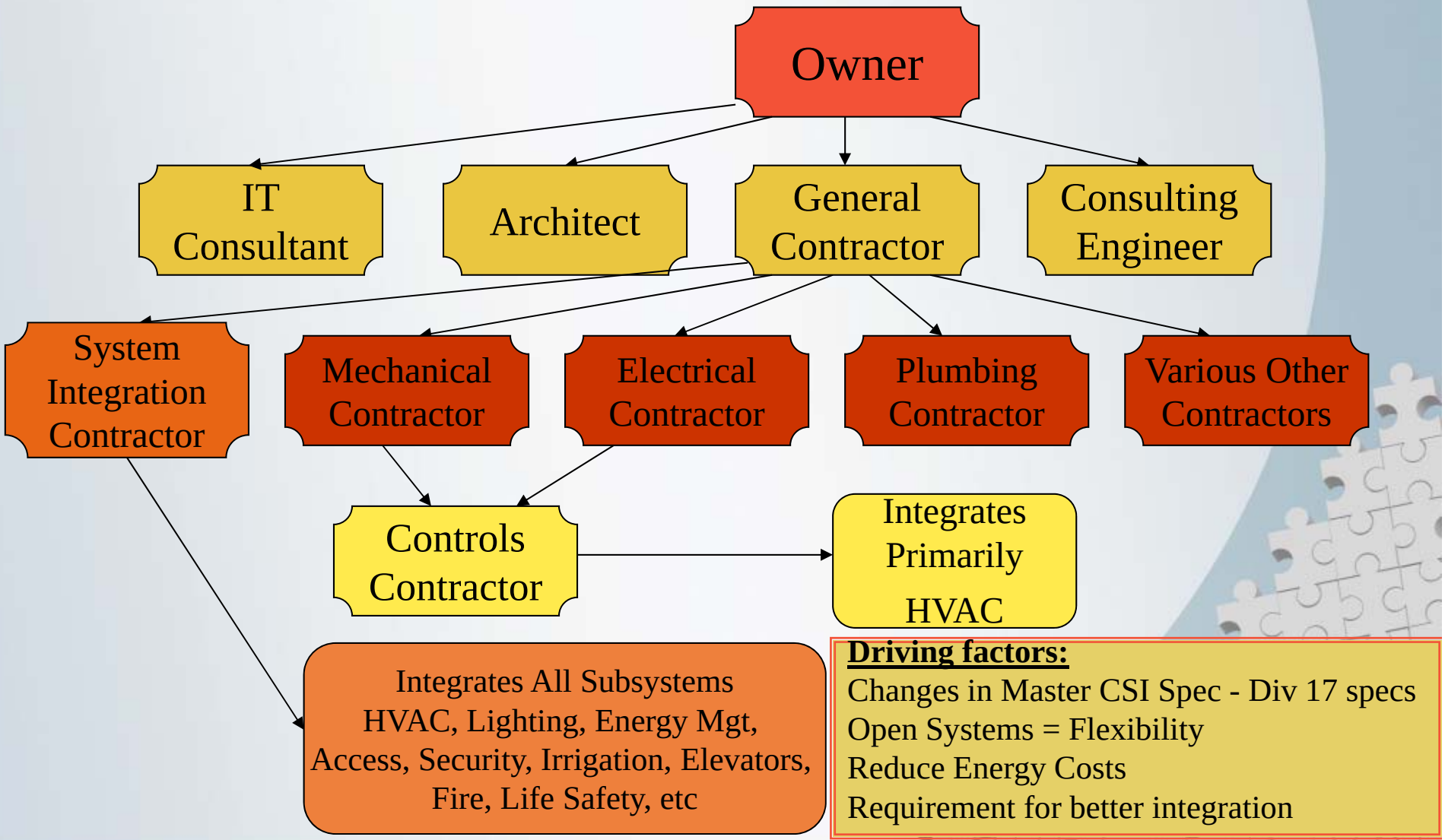
The Changing Contractor World
Typical System – Single Building
Enhanced System Integration



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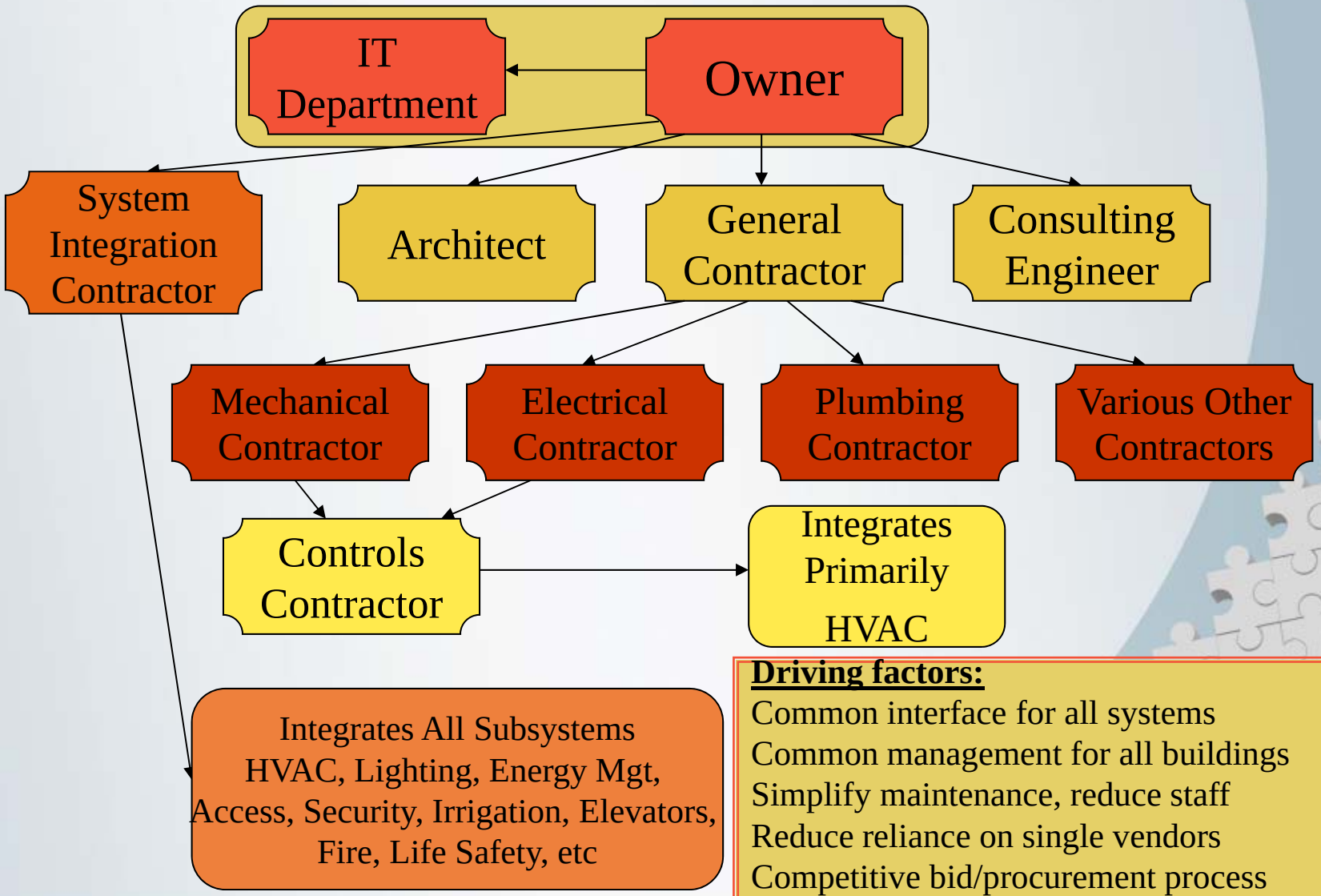
The Changing Contractor World
Open Systems Changes the Model – Multi-Premise



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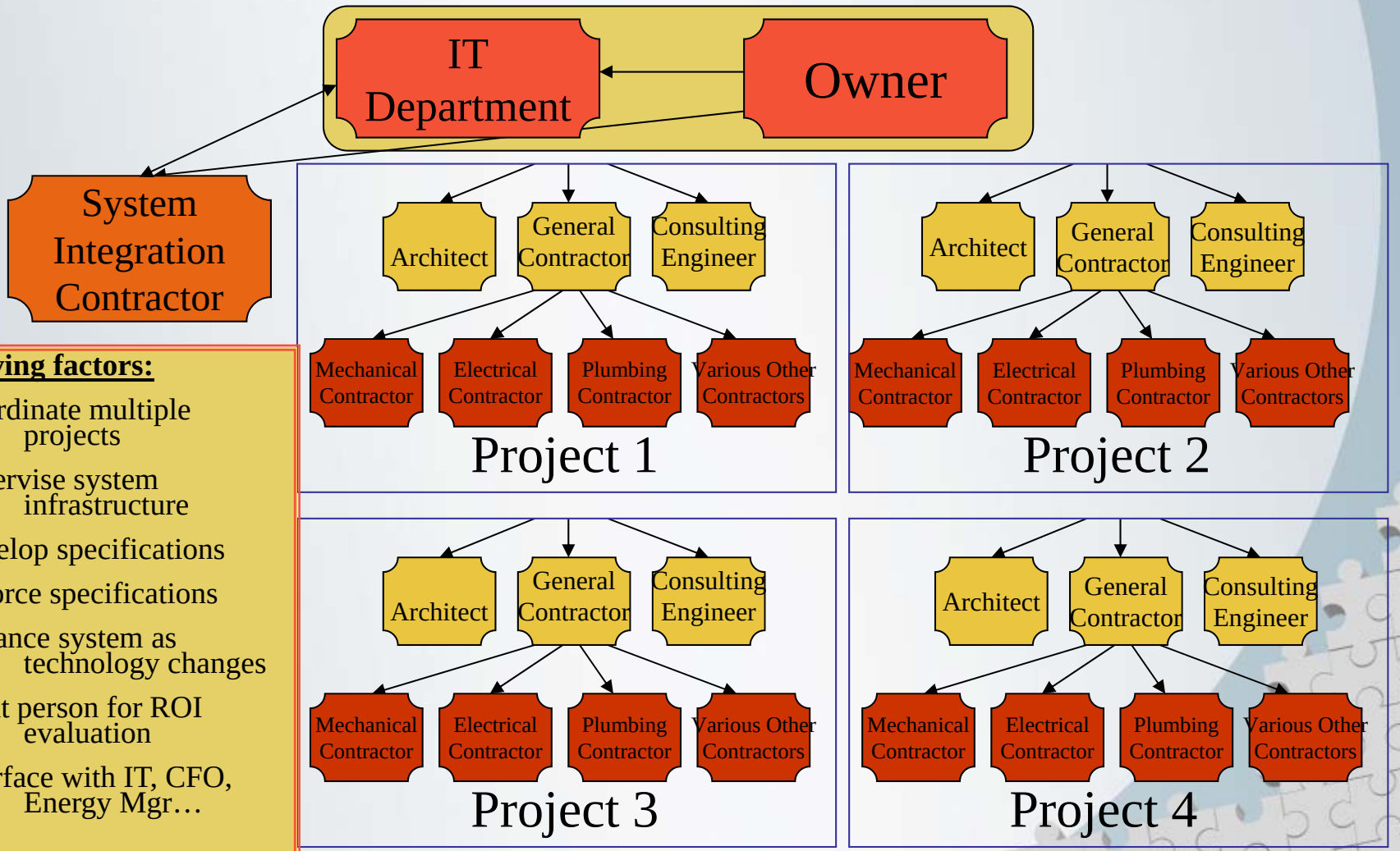
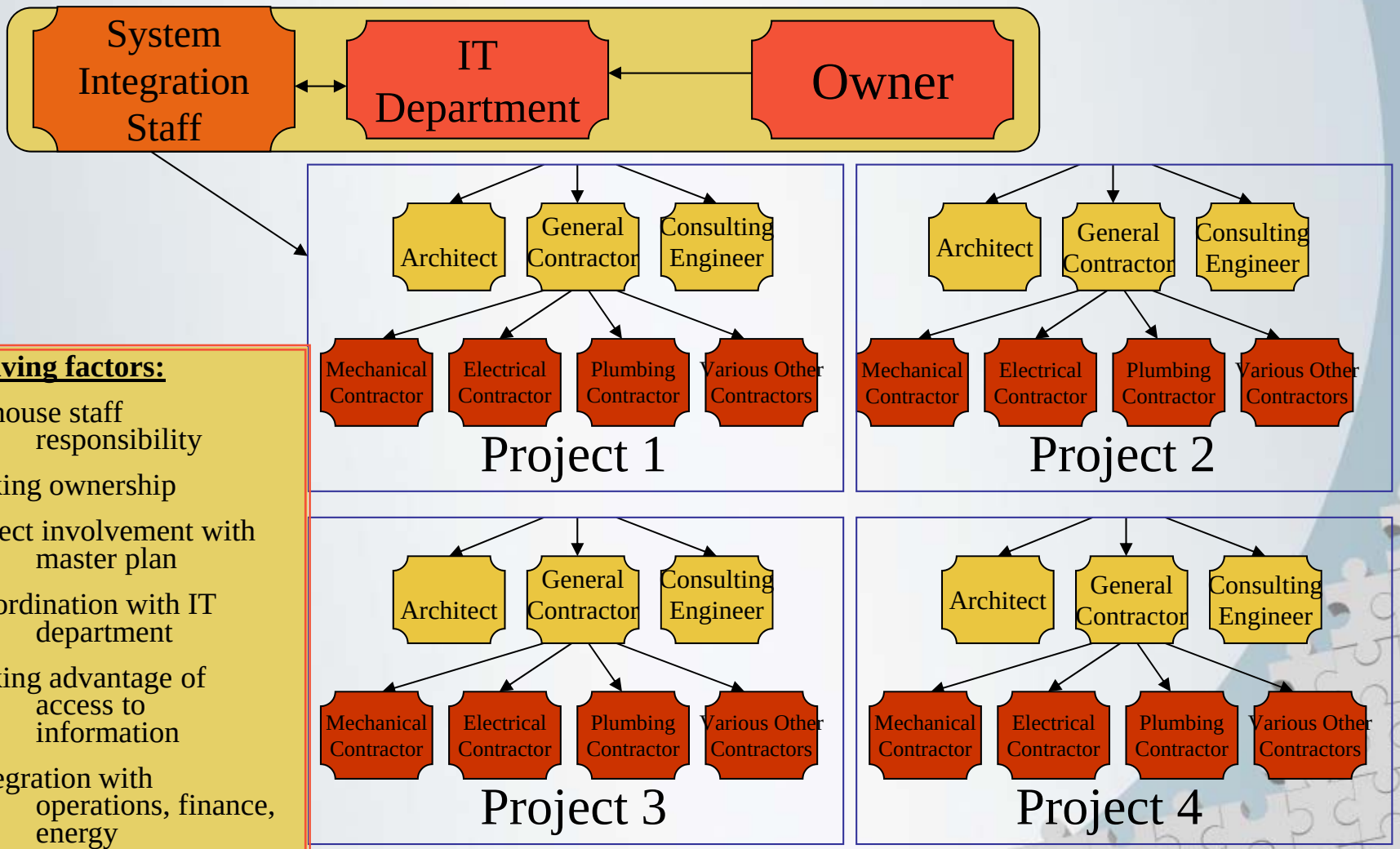
The Changing Contractor World
Open Systems Changes the Model – Multi-Premise



Driving factors:

- Coordinate multiple projects
- Supervise system infrastructure
- Develop specifications
- Enforce specifications
- Enhance system as technology changes
- Point person for ROI evaluation
- Interface with IT, CFO, Energy Mgr…

The Changing Contractor World
Open Systems Changes the Model – Multi-Premise



Driving factors:

- In house staff responsibility
- Taking ownership
- Direct involvement with master plan
- Coordination with IT department
- Taking advantage of access to information
- Integration with operations, finance, energy