Simplifying Device and System Integration Specifications for Building Automation Systems

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Advancements in BAS Specifications

- Greater system integration – going beyond just HVAC
- 3 Tier Architecture Model
- Networking requirements (IP, control)
- Example BAS sub-system interfaces
- Device level profiles and interfaces
- Communication protocol options
- Legacy system integration options
- Details for specifiers
Integration using a common BAS platform improves system functionality

Defining roles and responsibilities provides greater flexibility – more choices of supply

Higher level of integration – things work together

Higher levels of scalability – common system architecture

Easier to manage – common management platform

Lower life cycle costs – both CAPEX and OPEX

Better intelligence at the point of control – see more and do more
Unlocking the value of integrated building automation systems

- Total facility control model improves decision making
- Access to better system analytics, tools, and analysis
- Improve overall facility energy and operational costs
- Greater system scalability through a common system architecture
- Common graphical user interface across multiple sub-systems provides better access to information
- Leverage IT standards and an IP backbone
- Greater choices in vendors and suppliers
- Improve roles and responsibilities of vendors, contactors, and designers

Open Integrated Building Systems
What Is An Open Integrated System?

• The ability to install devices from multiple subsystems and from multiple vendors into a single cohesive system.
Ability to network (system and subsystem)
Ability to collect information (historical)
Ability to see information (real time)
Ability to process information (analyze)
Ability to make decisions (report)
Ability to compare (baseline evaluate)
Ability to validate over time (trend)
Ability to control (take action)
3 Tier Architecture Model of System Components

Tier 1
Enterprise IP Network
- Site/Enterprise – Software, Servers
  - User Interface, Database, Analytics,
  - Demand Response, Load Shed
  - IP Backbone, VLAN, Web

Tier 2
Building Level Network
- Multiple Sub-System Integration
  - HVAC, Lighting, Metering
  - Open Building Control Network
  - Communication Infrastructure

Tier 3
Sub System Equipment
- Building Equipment and Controls
  - Chiller, AHU, Light Panel
  - Connectivity to Control Network
Define design requirements for each tier

Establish roles and responsibilities for each sub-system into the BAS

Define handoff between tiers

Follow an IT model of data and control networking
Tier 1: Control and Data Network

Expanded discussion on protocols
- RF options
- Wired options
- Data management

IP integration
- Details on system architecture requirements
- Security and reliability
- Control and Monitoring

Front end applications and management
- GUI tools
- Analytic tools
- Management tools
- Big data mining (databases)
3-Tier System Architecture

Enterprise IT Network

Tier-1
- Network Database
- Graphical User Interface
- Network Tools
- Diagnostics
- Web Interface
- Firewall
- IT Switch
- Dashboard Interface Network Tools
- Diagnostics
- Web Interface

Site/Bldg. IT Network

Tier-2
- Router
- Data Server
- Web Server
- Alarm Server
- Firewall
- IT Switch
- Options for IP enabled equipment

Control Network

Tier-3
- Standard Network Variables
- Exchanged Between Devices
- and to PC, Web, Remote Access

Sensors/Actuators
- Standard 4-20mA, 0-10VDC, relay wiring

Remote Access
- Email and TXT Alarms
- Browser Based Monitoring and Control
- Smart Phones, Tablet Access

Enterprise Applications
- Building Operations Center
- Call/Dispatch Center
- Reporting/Scheduling
- Energy Analytics, Dashboards, Kiosks

Tier System Architecture

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

Sensor/Actuator Wiring

Smartphone/Tablet Access

Email and TXT Alarms

Browser Based Monitoring and Control

Remote Access

Graphical User Interface

Network Tools

Diagnostics

Web Interface

Enterprise Applications

Building Operations Center

Call/Dispatch Center

Reporting/Scheduling

Energy Analytics, Dashboards, Kiosks

Site/Bldg. IT Network

Tier-2

Router, Data Server, Web Server, Alarm Server

Firewall

IT Switch

Options for IP enabled equipment

Control Network

Tier-3

Sensors/Actuators

Standard 4-20mA, 0-10VDC, relay wiring

Graphical User Interface

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BMS Enterprise Interface – Tier 1

User Interface
- Central management workstation
- Web browser interface
- Graphics library
- Alarm setup and routing
- Trends, scheduling

Connectivity to Enterprise
- IT integration
- Switches
- IP Addressing
- Backups

Security
- User accounts
- Administration
- Passwords
- Firewalls

Common Suite of Applications
- Control and monitoring
- Energy management
- Alarming, Trending
- FDD (Fault Detection and Diagnostics)
- Demand response

Enterprise Responsibility
- End User/Owner In house or
- FMSI contractor or
- BAS contactor
- IT coordination required
Tier 1 - Specification Requirements

Enterprise Graphical User Interface (GUI)
- Graphics
- Dashboards
- Connectivity to other systems
- Analytics, Reporting, Trends, Data Logging

Software
- Applications
- Security, virus, malware
- System databases
- Equipment profile details
- Points list integration requirements

Hardware
- Servers
- PCs
- Switches
- Routers

IT Connectivity
- Security – Firewalls
- IP Addressing
- Backup requirements
Facility Master System Integration (FMSI) Responsibilities

Enterprise Applications
• Enterprise application configuration
• Front end graphics
• Alarming system
• FDD – Fault Detection and Diagnostics
• ADR – Automated Demand Response
• Analytics
• Energy management

Building Management System
• GUI – Graphical User Interface
• Common dashboard look and feel
• Database management and maintenance
• BMS software integration, programming, and tools
• Operational training, documentation, support, service
• Lobby Kiosks

Integrate Tier 2 and 3 equipment into BMS
• Building Automation System Panel Integration
• HVAC, Lighting, Fire, Gas, Energy, etc.
• Oversee equipment supplier compliance to standard
• Coordinate sub-contractor responsibilities
• Ensure vendor submittal compliance
Example integration of various sub-systems into the BAS:

- HVAC
- Lighting
- Security
- Fire/Life safety
- Gas detection
- Metering
- Room control
- Daylighting/Shading
Lighting Control System Tier Architecture

**Enterprise Level Tier 1**
- Internet/VPN
- IT Enterprise LAN
- Corporate Server or Cloud

**Site IT LAN Ethernet Wiring**
- LAN to WAN Connectivity
- Building BAS PANEL BAS to LAN Router
- BAS Control Network Wiring
- Site IT LAN Ethernet Wiring
- Free Programmable Network Controller

**Equipment Level Tier 3**
- Lighting Control System

**Sensors and Actuators**
- Sensor Wiring
  - Dimming
  - Photocell
  - Relay
  - Motion

**Building Level Tier 2**
- Building BAS PANEL BAS to LAN Router

**Option A:** Lighting control with direct BAS control network interface connection

**Option B:** Lighting control stand-alone with shared relay(s), dimming, and motion sensor(s) connected to programmable network controller

**Equipment Level Tier 3**
- Lighting Control System (Stand-Alone)

**Equipment Level Tier 3**
- Field Device Wiring
- Equipment Level Tier 3
- Sensors and Actuators

**Legend:**
- Orange: Enterprise LAN/WAN/VPN
- Red: Site/Building LAN – Ethernet
- Blue: BAS Control Network Wiring
- Green: Field Device Wiring
**Fire/Life Safety System Tier Architecture**

**Option A:** Fire panel with connection to HVAC equipment using shared relay, HVAC equipment communication of fire system to BMS over BAS control network

**Option B:** Fire panel connection to BMS using shared relay connected to free programmable network controller

![Diagram of Fire/Life Safety System Tier Architecture](image-url)
BAS Infrastructure – Tier 2

Control networking infrastructure
- Communication backbone
- Network protocol
- BMS interface

Connectivity to data network
- Ethernet, WIFI
- Network security
- Network interfaces and gateways

BAS Integration
- Data points connectivity
- Programmable controllers
- Sequence of operation
- Local display graphics
Tier 2 Spec – BAS Contractor

Integration
- Install backbone connectivity
- Supply BAS Panel
- Commissioning
- Device profiles
- Device points lists

Install routers, repeaters, network interfaces
- Twisted pair, RF, Powerline, Ethernet for controls

Provide network management, commissioning, and setup
- Addressing
- Binding
- Configuration

Test and validate network
- Network analyzer
- Bandwidth usage
- Error rates
- Compliance reporting

User interface setup
- Panel display setup
- Graphics
- Alarm setup
- User accounts

Local GUI setup
- Alarming Trending Scheduling setup
Define device integration requirements

- Control
- Monitoring
- Logical I/O
- Physical I/O
- Algorithms

Common device profile...
Common Profile Model

Control

Local User Interface

Actuator Out 1
Input Value 1
Output Value 1

Actuator Out 2
Input Value 2
Output Value 2

Actuator Out 3
Input Value 3
Output Value 3

Comm Out
Input Value 4
Output Value 4

Control Algorithms
Internal Logic
Local Data Logging
Local Alarms
Local User Interface

Monitor

Sensors

Sensor Input 1
Sensor Input 2
Power In
Comm In
Thermostat Profile Example

Control Algorithms
- Call for Cooling
- Call for Heating
- Deadband Adjustment
- Demand Response Adjust

Local User Interface
- Display 1
- LED 1
- LED 2
- Comm Out
- Zone Temp
- Setpoint

Sensors
- Sensor 0-10ma
- Power In
- Comm In

Control
- Setpoint Value
- Schedule 1
- Schedule 2
- Mode 1

Monitor
- Sensors
- Local User Interface
HVAC Sub-System Profile Example

Control Algorithms
- Cooling
- Heating
- IAQ
- Comfort
- Energy Conservation

Resources
- Electricity KW
- Gas BTU
- Fresh Air

Comfort
- Zone Temp 1
- Zone Temp 2
- Zone Temp N

Monitor
- Status
- Alarm

Control
- Demand Response
- Cooling
- Heating
- On/Off Override
- Schedule
Equipment – Tier 3

Packaged equipment
• HVAC Chiller, Boiler, Heater, Fire System, Lighting Panel

Individually specified

Complete functional operation set by supplier

Embedded control sequence of operation

Installed by
• Tier 2 BAS Integration Contractor (typical)
• Tier 3 Supplier (not typical)
 Tier 3 Spec Equipment Supplier Responsibilities

Equipment performance
- Ratings, Load, Duty Cycle

Design Engineer responsibility to size

BAS controls integration

Interoperability
- Points list
- Data sheet, operational details
- Equipment Profile

Installation requirements
- Wiring, power, termination
- Location, environmental
Division of Responsibilities

**Design Engineer**
- System design
- Equipment specification
- General requirements for integration
- System architecture

**Traditional BMS Controls Contractor**
- Hired by Mechanical/Electrical Contractor
- Only sees his scope
- Limited or no integration

**System Integrator**
- Performs and or manages all work related to Building Automation Systems
- Better integration capabilities

**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 agreement
- Applies to larger Multi-Building systems, longer term projects
- Allows for easier management of multiple vendors
Legacy System Criteria

Provides example scope

- Warranty status/availability
- Parts available
- Serviceability
- Reliability
- Cost issues

Defines choices...
Legacy System Options

Integration
- No changes to existing system
- Add gateways or interfaces
- Access to legacy system information

Upgrade
- New software, new interfaces, same controls, same equipment
- Enable interface to “other” systems

Replace
- Remove control hardware and software
- Keep equipment
- New controls
- New software
IT Integration Issues

Application access from BAS and IT networks
- Web, API, Database Sharing

Security
- 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
- Data size and frequency of updates

Management
- IPV4 vs. IPV6 access

Refer to corporate standards in IT Spec
Issues

- Country specific requirements
- Inconsistent specification standards
- Variable contractor roles
- Local codes, norms, and standards
- No national or international standards for BAS specifications

Opportunities

- Work with like minded groups
- Develop common specification elements
- Propose national and international standards
- Work with key end users on a template and adoption plan
- Grow the value for open integrated building systems
LonMark’s Value

Control and Communications Platform

- Device level protocol ISO 14908 Standard
- Interoperability through standardization

Open Device Profiles

- LonMark Device Profile Development
- Over 380 unique device definitions
- Standardized data communications
- Standardized network variables

Product Testing and Certification

- Over 1000 products have been tested and comply with the standard

LonMark Certified Professionals

- Over 800 people worldwide are certified
- Offered in English, Spanish, German, Japanese, Russian
LonMark Ongoing Activities

- Over 120 Million LON devices installed in over 500,000 systems
- Helped develop new BAS Guidespec
- New standards for the Oil and Gas industry
- New standards for the restaurant market
- New standards for the outdoor streetlighting market

New ANSI/CEA Standards

- ANSI/CEA 709.5 and 709.6 Standards Released
- Application elements - .5 – SNVTs, SCPTs, ENUMs
- Standard LonMark Profiles - .6

Industry Leadership

- Education and promotion of open standards
- Extending the value of interoperability beyond LONWORKS
- UPnP, CEA, ASHRAE, BACnet, Haystack, VDI, and others

LonMark Certified Professionals

- Over 800 people worldwide are certified
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Questions?

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