Connectivity: Providing the Gateway to Open Systems.
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Open systems provide facilities managers within dependence to select components based on features and performance rather than protocol.

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From power management to business information networks, HVAC to access controls, modern buildings contain a dizzying array of systems and equipment. Until recently, each system was viewed as an isolated application with little consideration as to how it might interact with other systems within a building. More often than not, it has been up to clever facility managers to coordinate and monitor all the various systems to ensure smooth, efficient operations – a nearly impossible task.

One weapon in the arsenal of facility managers is the direct digital controller, which enhances control capabilities. Mounted on or near the equipment they control, these programmable devices can stand alone, or send and receive data as part of a network. They do not depend on the network for basic control, nor do they busy up the network by sending unwanted information.

This option is possible because, fortunately, most equipment manufacturers are beginning to include electronic controls and communication ports in their product designs. Overall, the transition from simple electrical contact to information-carrying electronic signal and information systems has been made by major subsystems as well as smaller subsystems. Almost every large piece of mechanical or electrical equipment with any degree of sophistication has some electronic controls and some means of communicating with the electronics through a RS-232C port.

Connectivity in building systems, with cooperating vendors, allows the facility management system (FMS) to read and write to the memory of this equipment. Boilers, chillers, rooftop units and electrical distribution equipment are among the equipment included in today's connective scheme. Also included are water-source heat pumps, fume hood controls and power monitoring equipment.

There is also a move toward more intelligent controllers which provide expert and automatic engineering functions that previously required expert field commissioning engineers. Smaller, secondary controllers that can be networked to provide a greater system distribution will adjusts to provide the best environment for the painting process.

Finally, the open system standard will allow for the sharing of communication media as much as communication traffic will allow. The building automation system should be able to use existing media, or common data highways already in place at the site. For example, the high-band width local area networks (LANs) between buildings on a university campus or existing office automation networks may also be used by the building automation system, and other potential pathways include those used for office and manufacturing control systems.

MULTIPLE PROTOCOLS EMERGE

With these four issues driving the trend toward open systems, there have been a number of efforts within the industry to develop a single standard protocol. A few words of caution, however. Dedication to a

single protocol could limit functionality and increase the expense of integrations to other products. Further, a single protocol solution may not provide the common user interface for all subsystems. It can also limit a customer's vendor independence when it is time to upgrade or enhance a control system. To date no single protocol has emerged as a standard that all building equipment or control systems can use, although many national and international groups have moved ahead in pursuit of this goal.

Nearly everyone in the industry agrees with the goal behind open protocols – to allow devices from different manufacturers to communicate with each other by speaking the same language. A brief look at the three most significant protocols in the North American building automation industry – BACnet, LonWorks™, and CAB – will highlight some of the inherent issues.

Building Automation and Control Network (BACnet) was developed by the American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE). BACnet is a communication and data protocol suite designed to connect building automation components from various manufacturers. A device may be designated as BACnet-compliant by adopting BACnet communication protocol and data definitions. To comply with the standard, there are five different combinations of physical connection and data transmission that can be selected.

The BACnet protocol can be used by head-end computers, general purpose direct digital controllers, application-specific or unitary controllers, and smart sensor/actuator devices. The level of communication sophistication is defined by six conformance classes. The BACnet standard defines data communication services and protocols for controlling HVAC, refrigeration, and other building systems. BACnet provides a comprehensive set of messages for conveying encoded binary, analog and alphanumerical data between devices.

LonTalk, or Local Operation Network Protocol, is designed to provide communications on a variety of physical media for a wide range of products and systems in building automation and other network distributed controls. Developed by the Echelon Corporation, the protocol is implemented in a dedicated VLSI component, the Neuron chip for computing and communication, and supports several transceivers for different physical media.

The LonTalk protocol follows the ISO Open Systems Interconnection Reference Model containing all seven layers. It is designed to support twisted-pair wiring, power-line wiring, radio frequency and infrared communication, as well as coaxial and fiber optics media.

Canadian Automated Building Protocol, or CAB, was developed under the direction of Public Works Canada. CAB is a suite of services designed to provide functional needs for the supervision, operation and maintenance of building systems. Using a LAN between gateways and workstations, it provides links to other computer-based processes, executing energy performance analysis, building equipment diagnostic assessment, or other real-time audit or management accounting systems.

At the application layer, CAB divides data items into two categories: general data items and function-specific data items. General data items include the traditional point objects, such as digital input, digital output, analog input, analog output, supervised and PID controller. Function-specific data items identify common building automation operations, such as access control, virtual terminal events and alarms, schedules, trends, files and time/date.

By themselves, these protocols do not provide vendor independence; they make vendor independence possible. Likewise, open protocols do not provide a single-seat user interface; they make a single-seat user interface possible. Another important consideration with emerging protocol standards is that they

have really not addressed the needs of existing building automation systems. This represents a significant investment for buildings already using an automation system.

BEYOND OPEN PROTOCOLS

If a building's current system uses proprietary protocols, facility managers are faced with three choices. They can remain proprietary, completely replace their current system, or find a door to open systems that provides a migration path. Given these conditions, and understanding that most facility managers would prefer to connect existing equipment, how will building control systems provide integration in a world of products with different protocols?

The answer goes beyond open protocols to an integrating architecture for building automation systems. This can be defined as a network system architecture that integrates devices and subsystems using multiple communication protocols.

Building automation systems, and all of the different systems within a building, such as fire protection, access control, lighting control, power monitoring, and others, have typically operated as isolated and independent islands.

Within the current trend toward connectivity, an integrating architectural network provides the structure to integrate equipment and building subsystems into one heterogeneous network, regardless of the type of communication protocol. In short, it is the "glue" that binds the different pieces of equipment and building subsystems within a facility. In fact, such an architecture can even integrate existing competitive systems.

Such architectures, or facility management systems, provide the pathway to a truly open system. They offer a gateway to standard protocols, vendor independence, a single-seat user interface, inter-process interaction and media sharing. Facility managers can select products using BACnet, LonTalk, CAB and many other protocols, allowing users to design and implement custom systems that suit their needs, using off-the-shelf product from different suppliers. And for facility managers and building owners with large investments in an existing building automation system, integrating network architecture can protect that investment by providing a migration path to open systems. Under this scenario, gradual renovations and expansions can occur as the building converts to an open system and integrated facility.

Connectivity makes efficient use of staff expertise. With a single-seat and one method of interface, facility managers can leverage existing knowledge and experience. The current level of operator equipment knowledge remains viable, and substantial re-training is not required. In addition, with one workstation, employees can more quickly pinpoint trouble spots and are able to determine in advance what tools and equipment they will need to fix the problem. If an employee is on-call, he or she can even log-in to the system from home via a lap-top computer. This allows the employee to decide if temporary adjustments can be made from home, avoiding a trip to the facility.

Provided by an integrating architecture, connectivity creates opportunities for suppliers to partner. Vendors of the different major systems can come together to propose and provide packaged solutions offering the best equipment and best technology – without the user being tied to a solution offered by a single supplier.

Best of all, with vendors cooperating to provide an integrated solution, the planning and specifying for a retrofit or new construction becomes simpler. Connectivity-minded vendors will have done most of the preparation work as part of their joint development efforts. They can present a joint specification and bid that in effect provides a single-source solution.

EXPERTISE BEYOND CONNECTIVITY

As the pressure to increase productivity continues, the need for integration will increase. While open protocols such as BACnet, LonWorks, CAB and others are growing in popularity, there is still a need for someone to assume responsibility for making everything work together. Protocol standards are really just tools to achieve connectivity. Experience counts when bringing different pieces together into an integrated and open system.

Several third-party vendors offer innovative solutions to the challenges of connectivity through designing and developing system interfaces.
Centaurus Systems Inc., ABB Industrial Systems, Inc., and Ray Bernard Consulting and Design, in particular, have made strides toward closing the gap with operator-friendly technology.

Centaurus Systems, based in San Diego, California, has developed a new interface that connects systems from Honeywell, Robertshaw, Barber-Colman, and Landis & Gyr Powers to Johnson Controls Metasys Facility Management System (FMS). In conjunction with Metasys, these interfaces provide the transparent operation of building systems that facility managers are seeking.

ABB Industrial Systems Inc., headquartered in Milwaukee, Wisconsin, has also made significant contributions in the trend toward connectivity.
ABB manufactures variable frequency drives (VFDs), usually used on fans and pumps to vary the speed of the fan or pump to match volume demand and thereby reduce energy costs. One of their newest drives, the ACH 500 series, was developed to link without an integrator directly to Metasys.

This type of connection previously, if possible, to achieve, used up significant point space on the Direct Digital Control (DDC) system.
Additionally, the integrator panels sometimes added to the cost of installation. A simple EPROM change to the drive eliminated the need for an integrator panel, and the new direct serial communication protocol is embedded into the drive's microprocessor controller memory. A single serial port allows the building operator to effect drive functions, including speed-set adjustment, kilowatt feedback and warning/fault diagnostics. With the new protocol, HVAC designers can replace traditional wiring with a twisted-pair cable, saving nearly $1000 per point and up to 75 percent on wiring costs.

Finally, the Ray Bernard Consulting and Design Company (RBCD) has developed an integration kit that allows building owners to connect Andover AC 256 series equipment to Metasys. A software program called PointMap, developed by RBCD, helps to simplify the integration process.

The kit accomplishes the interface by connecting all input/output and data points, such as temperature setpoints and schedule times, into Metasys for operator review and control. Once installed, the building operator can monitor and control the Andover points via Metasys operator workstation software.

THE FUTURE OF CONNECTIVITY

Open systems and connectivity provide one solution to bring all systems together and present building owners with a way to cut costs and increase efficiency.

Connectivity provides the benefits of capital and operating cost savings.
The initial investment is less due to lower wiring, installation and labor costs. Connectivity supplies the user with a cost-effective means of ensuring that needless redundancies are not incorporated into new building automation systems. Maintenance and operating costs are reduced because information is

available and easily accessible for energy conservation, diagnosing problems, and directing maintenance. Existing equipment and levels of expertise are utilized rather than replaced.

Most importantly, connectivity traces its roots to the objectives of all building management equipment: creating a comfortable, safe building environment; controlling energy and operating costs; providing a vital business infrastructure; and helping to manage resources. Building owners and managers reviewing their building needs should take advantage of the new connectivity technologies and the spirit of vendor cooperation.

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