

# Networked Building Systems: the Revolution is Upon Us

## It's time to apply enterprise-wide thinking to the business of facility management

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Rapid changes in information technology (IT) and building automation have brought about some important new opportunities for the controls community. Until now, building-automation systems and IT systems have been considered completely independent functions. But this facility management model is outdated.

Enterprise-wide thinking has been applied to all other aspects of business: accounting, manufacturing, inventory control, quality control, human resources, etc. Why not apply this same concept to enterprise-wide facility management? Instead of thinking of building automation as merely controls, it is time to think of it as part of the overall IT infrastructure.

Open-system computer-control technology is an enabling technology for enterprise-wide facility management.

Open-system building automation allows two important advantages. First, it prevents a customer from being "locked in" to a proprietary control vendor. Second, it lowers the cost of interfacing disparate building systems.

Building automation should be viewed as the data-acquisition front-end

for enterprise-wide facility management.

Data collected from building automation systems, such as energy-consumption data, alarm data, and maintenance data, generally are wasted today. But this same data can—and should—be used to operate an enterprise more efficiently.

Bi-directional communication opens up important opportunities in enterprise-wide control by allowing the aggregation of data from multiple buildings. (Figure 1.) Examples include:

- Using real-time power pricing infor-

via building-automation systems (BAS); and

- Implementing shut-off strategies for HVAC and lighting based on occupancy.

### NETWORKED BUILDING SYSTEMS

The convergence of four key factors—enterprise-wide management, utility deregulation, the Internet, and open systems technology in building systems—has brought about a new revolution: networked building systems (NBS).

In this new revolution, enterprise-wide facility management and utility deregulation are the applications; the Internet and open systems building technology are the enablers.

I believe this revolution will result in increased profitability for all. This article describes the benefits, the technology and the applications of networked building systems.

NBS are a combination of hardware and software systems that allow:

- Communication within a building's systems (e.g., heating, ventilating and air-conditioning; fire alarm; lighting control; security; etc.) and/or

communication across multiple building systems into a central location.

- Applications that improve facilities operations.

### A TYPICAL NBS

A typical networked building system consists of several components, including:

- Existing and/or upgraded building

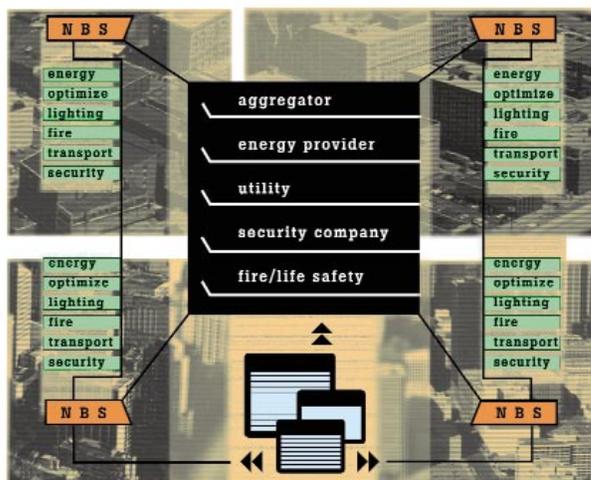


FIGURE 1. A networked building system example.

mation to determine fuel-switching/distributed-generation or curtailment options;

- Designing preventive maintenance strategies based on trend data collected

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controls.

- Routers and gateways which connect various building controls.
- A wide area network (WAN) that is either Internet- or intranet-based.
- Central management workstation(s) with applications or Internet-based application services.

- An interface with existing corporate-level IT infrastructure.
- IT applications.

NBS allow real-time connection, monitoring, and control of single buildings, campuses of buildings, geographically dispersed collections of buildings, and even entire cities.

Because NBS technology will be deployed over large numbers of diverse facilities, generating substantial quantities of information, the enterprise-wide applications that support NBS must have significant capacity.

Over the next 10 years, building-control companies, equipment and systems manufacturers, energy providers, utilities, and design engineers will face increasing pressure to improve performance and reduce costs. The development, adoption, and use of NBS will address these pressures by reducing the costs of operation, maintenance, energy, and regulatory compliance by almost a dollar per sq ft, allowing a one-to two-year payback on the investments needed to realize these benefits.

Today, the penetration of NBS within and across buildings still is low. This low penetration is the result of a proliferation of proprietary systems, which complicate the ability to install and broadly integrate information systems.

For example, trend data remains difficult to extract from building-automation systems, which makes analysis of long-term performance almost impossible.

However, the recent market acceptance of open standards for HVAC control networks such as BACnet, coupled with the tangible benefits promised by networked building systems, will drive rapid and widespread adoption of NBS over the next several years.

### **BENEFITS OF NBS**

Within the building marketplace, there are several broad categories of potential NBS beneficiaries:

- Building owners and managers, who will benefit by saving money.
- Construction and associated support service providers, who will benefit from improved commissioning capabilities.
- Emergency and security service providers, who will benefit from enhanced information acquisition.
- Utilities and energy providers, who will benefit from augmented energy-consumption profiles and trend data.

While the implementation of NBS will benefit members of all of these categories, building owners and managers and utilities and energy providers will realize the greatest benefit in the short term. These benefits will include:

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## NETWORKED BUILDING SYSTEMS

*Lower energy costs.* Access to and analysis of energy-usage data will deliver cost savings due to better control, an ability to aggregate multiple buildings' energy usage to negotiate lower electricity rates, and the optimization of real-time pricing. The ability to control distributed generation, curtailment, and fuel switching will

change the way power is purchased and generated in this country.

*Lower operations and maintenance costs.* The more efficient allocation and deployment, and shorter duration of on-site man-power resources will result in reduced overtime expenses, reconfigured and/or reduced operations-and mainte-

nance staff functions, and the use of third-party operations-and-maintenance contractors. The aggregation of alarm data, advanced predictive maintenance, and job and personnel tracking also will greatly lower operating cost.

*Lower repair and replacement costs.* The use of NBS will allow systems and equipment to be automated and operate under near-optimal conditions for extended periods of time. In addition, equipment and component malfunctions will be diagnosed and quickly remedied before catastrophic failures occur. As a result, equipment life will be extended, fewer replacements will be required, and replacement costs will decline. Furthermore, better diagnostic tools will enable support staff to more quickly and effectively repair equipment and components.

*Increased occupant productivity.* NBS also will result in improved occupant comfort from the enhanced operating performance of HVAC and lighting systems. Maintaining temperature, humidity, and air quality will give the building operations staff the information to provide a more consistent environment and quicker response time when change is necessary. Improvements in comfort and control have major impacts on worker productivity and tenant loyalty.

*Integration with IT systems.* NBS will permit the easy and cost-effective integration of enterprise-wide facility data into existing IT systems, which will provide more centralized control for operations, purchasing, financial management, compliance, and regulation.

### **ADOPTION OF NBS**

The rate of adoption of NBS is beginning to increase at a rapid pace due to:

- The spread of the development of open systems in the building arena.
- The emergence of an enterprise-wide management paradigm.
- The growth of the Internet, broadband wide-area networks (WANs), and the World-Wide Web.

### **OPEN SYSTEMS**

Just as TCP/IP and other standard protocols were crucial to the development of the Internet, open systems based on industry standards are critical to the development and deployment of new tech-

nologies in the building industry.

The building industry has adopted BACnet as an open standard for data communication. BACnet makes the integration of building systems significantly more straightforward.

BACnet graphically represents the internal functioning of control equipment on a common network in a uniform way—regardless of vendor.

This feature recognizes and protects the proprietary nature of each vendor's internal design, while allowing information to be shared with other devices on the network.

BACnet maps the internal data structures of a control device into a common, well-defined abstract data structure known as an object. These objects form the basis of industry-wide data definitions that greatly lower the cost of interfacing with individual pieces of building-automation equipment.

These data definitions can be used for both NBS and the local integration of other building systems—HVAC, lighting, fire, security, etc. They can be used from the smallest sensor to the largest database. (Figure 2.)

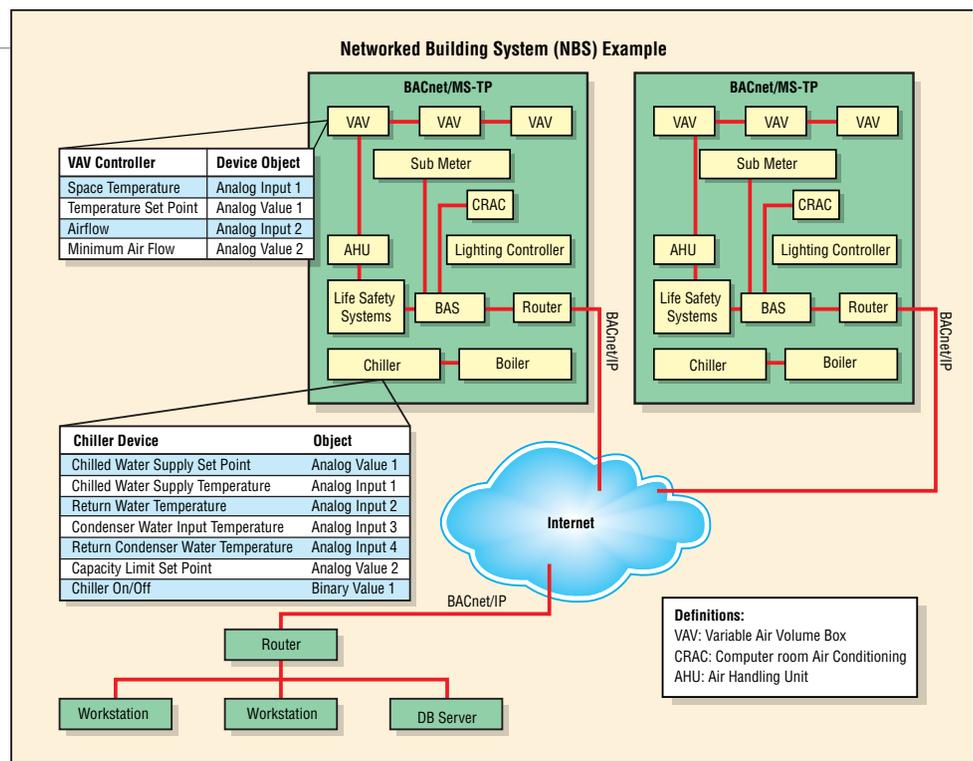
Common data definitions and network service definitions from the device level to the application level allow the construction of NBS, minimizing the use of gateways. Here, the idea is to move the same data around (routing) instead of having to recast the data at every stage.

## NETWORK PIPELINES

Until recently, communication between buildings typically required the use of telephone lines. Now, low-cost Internet and WAN communications systems enable the cost-effective movement of large amounts of information across multiple locations.

Today, almost all large facilities are being wired for Internet communication. There are a number of leading companies that have become very successful at deploying this type of technology. Now, building-automation systems are being designed to work directly with newly developed Internet-based systems.

Most building-automation equipment manufacturers are including BACnet/IP technology in their product offerings so users can send building



**FIGURE 2.** This Networked Building System (NBS) data-flow diagram depicts BACnet objects moving from various devices to a central database via the Internet.

automation-data over the Internet. This allows the user to connect campuses and aggregate multiple buildings in different geographic locations without dedicated telephone lines.

Some have suggested that Internet technologies will make protocols such as BACnet unnecessary.

Actually, the Internet makes BACnet even more valuable. Using the Internet, BACnet messages can carry building data across the enterprise from building controllers to workstations and databases at high speed.

Even if you choose to connect building controllers to terminal unit controllers over the Internet, common data definitions and network service definitions like those in BACnet are necessary for machine-to-machine communication.

## THREE LEVELS

Eventually, NBS data will be manipulated by three levels of IT systems.

- Web browser-based application services (either central application-service-provider model or locally hosted).
- Traditional workstations (e.g., those which are Windows-based).
- Data applications that move raw BACnet data directly to corporate IT systems.

These systems will be designed, specified, installed, and maintained by a new breed of company that has ex-

pertise in networking, databases, building management applications, and building automation.

## ENTERPRISE MANAGEMENT

Major corporations have embraced enterprise-wide management systems in supply-chain management, human resources, finance, and manufacturing. This kind of management system takes into account the entire enterprise, integrating all parts and processes to increase control and reduce costs. The extension of enterprise-wide management systems to building management is a logical move.

Currently, facility-related information is contained in discrete “islands of automation.” Such information typically is not integrated with enterprise-wide IT systems. Instead, it resides within the facility.

With NBS, such data will be included in the integrated business systems of a large enterprise.

Until recently, it was not possible to integrate facilities data into enterprise-wide information systems. Controls functions usually were carried out with small-scale proprietary networks that, by design, could not communicate with each other. Data definitions were not standardized; active human monitoring was required; and interconnectivity was limited to intra-building at best. Inter-

building standardized data transfer and control was unheard of outside a few expensive and highly specialized communication “pipelines.”

NBS data will be acquired from the building according to the type of building-automation system currently installed. If the building is using native BACnet open-system controls, then this information (point data represented as BACnet objects) simply will be aggregated at the local building controller level and then routed over the Internet to a database server.

If the building is using a proprietary control system, a gateway at the site provided by the control-system manufacturer—or by a third party—will translate the proprietary data definitions to BACnet. Once in BACnet form, the data will be routed over the Internet to the database server.

Information stored in the database as BACnet objects and services will be processed by NBS applications. It is important that the information main-

tained in the database remain in standard form so that different application modules can access it.

### **APPLYING NBS**

The advent of a standardized data communications protocol allows for seamless transmissions across the corporate intranet and Internet levels. Having a standard protocol removes the obstacle that had prevented the integration of facilities-management equipment and controls with enterprise-wide management systems. The resulting product of this integration is the comprehensive NBS. NBS offers the data-acquisition and controls structure needed to add value to enterprise-wide management applications.

By collecting energy-consumption data using submeters, facilities managers can get the information they need to analyze building and equipment performance and evaluate possible energy-cost-savings measures. Armed with this information, it may be possible to negoti-

ate more favorable contracts with energy suppliers. In addition, there are opportunities for load aggregation, tenant billing, and energy-cost allocation.

New energy-rate structures such as real-time pricing will place additional demands on energy managers. Local generation will be cost-effective in even more situations, while the ability to remotely monitor and control generation equipment will be valuable. In addition, load curtailment, load shedding, and fuel switching will become increasingly important tools for controlling energy costs and decreasing emissions. This will lead to performance assurance at many levels, including:

- Compliance with codes, standards, and regulations.
- Liability and litigation protection associated with worker and/or tenant complaints.
- Energy and economic performance in accordance with contracts with utilities and performance contractors.
- Voluntary above-code performance

programs, such as EnergyStar, that require data for certification or recertification.

- Marketing programs that sell tenancy based on IAQ, energy efficiency, comfort, reliability, or other criteria that lead to reduced churn and higher profits.

Many buildings could benefit from improved control sequences. For example, new applications can be developed that will use building data collected over long periods of time to construct simulation models of buildings. These models will recommend control sequences that can reduce energy costs and improve the comfort of building occupants.

Maintenance management can benefit from direct communication with the building equipment. Applications include maintenance-work-order generation and tracking, asset tracking and the centralized dispatch of maintenance personnel.

Through integration with accounting systems, purchasing and cost allocation may be streamlined. For example, shut-

off strategies for lighting and HVAC systems will reduce energy consumption and increase equipment life.

Remote monitoring of building systems often reduces personnel costs. Access control and fire-alarm systems are frequently remotely monitored today. Increasingly, other building systems such as HVAC, lighting, and elevators also will be actively monitored, especially when the systems are mission critical (e.g., telecom and computer facilities).

The goal is to respond to imminent problems, not just alarms indicating a problem has occurred. Many businesses—especially those in telecommunications, manufacturing, data processing and health care—would much rather know that thresholds are being approached, not breached.

### WHAT'S NEXT

NBS is changing the way the controls domain is treated by bringing it into the IT age. Standardization of machine-to-machine communication

now allows facilities data to be integrated into enterprise-wide management systems.

In the next 18 months, look for the controls domain to be further absorbed into traditional IT models and systems.

While this endpoint is assured, there are multiple paths that will be taken to get there. Ongoing questions will include:

- Who will control these systems—the facilities department or the IT department? Early indications are that IT will play the dominant role. Some companies are combining facility management and IT departments.

- Who will control the energy/facilities data—the owner or the utility?

It will be interesting to see if a single leader emerges in encouraging and/or incorporating these controls domain changes.

With strong benefits becoming available to all sides, it is in everyone's interest to drive these networked building systems forward. ■