White Paper: BAS in Healthcare

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Driven by new and expensive technologies and an increasing demand from a population living longer than ever, hospitals and other healthcare facilities are facing increasing pressures to be competitive and contain costs. An often-overlooked area offering significant potential improvement in reducing overall operating costs is the facility's building controls system, which can be silently bleeding away money.

Studies show that hospitals require 150 percent of the energy per square meter of floor space than commercial buildings do and, unlike commercial buildings, they have 24-hour occupancy loads. The single largest share of this energy consumption is in interior climate control which accounts for about half of all the energy used by the facility. Studies conducted by the U.S. government have concluded that energy consumption can be reduced by 20 to 40 percent in private and community hospitals. The selection of the right building automation system can yield significant benefits to the healthcare facility's bottom-line on this one point alone.

Unfortunately, hospitals tend to be unusually loyal to whatever incumbent system is presently installed in their facilities. Although there are many benefits to such loyalty, there can also be hidden costs—particularly when the system is comprised of pneumatic controls.

> ***As*** the cost of the underlying technology continues to drop, [building automation] systems will become ever more sophisticated, providing more performance for lower cost, with greater efficiencies in energy and overall cost reduction associated with operation and maintenance of healthcare facilities.

DDC Systems

Some healthcare facilities have realized the first step in cost containment via their building controls system by installing or upgrading to "direct digital control" (DDC) systems. DDC systems first appeared about 25 years ago, replacing the old air-pressure tubing of pneumatic systems with digital communications networks and simple computer-based controllers. Since then the systems have grown in capability and speed, and the communications networks sometimes reach right down to the wall thermostat.

Compared to pneumatics, there are a myriad of benefits to DDC systems. First and most obvious is the more precise room temperature control possible with such systems. Not only can this save energy over poorly controlled rooms, but it improves patients' and physicians' comfort, also contributing to enhancing the facility's overall image. Facilities which in the past hid room temperature information from patients and nurses due to poor temperature control now make thermostat settings directly available.

Further energy savings are achievable with DDC systems by relaxing the precision of a room's temperature control when that specific room is unoccupied, thereby reducing the room's heating or cooling requirements while maintaining an established minimum airflow through the room.

However, DDC systems' environmental control capabilities do not stop with mere temperature control. They are able to measure and precisely control humidity and pressure as well, which can be important for critical areas such as surgeries, research laboratories and clean room facilities.

Other benefits of DDC systems include: the ability to schedule various operating modes, issue alarms when predetermined aspects of the building and its equipment are outside normal conditions, and automatically record information about the building's operation over time for system "tuning," energy audits, and other purposes.

DDC systems installed in healthcare facilities can also often support other tasks such as medical gas level monitoring, lighting control, emergency generator fuel tank levels, and so on.

Particularly valuable in a healthcare DDC system are its remote diagnostic capabilities. These allow much of a facility engineer's work to be done remotely from a computer workstation reducing, for example, the amount of time physically accessing equipment behind ceiling tiles and thus potentially exposing patients to infectious agents. They permit quicker analysis of system problems, because the diagnosis can often be performed right from the workstation.

These capabilities also improve manpower utilization, relieving the drudgery of frequent tours through the hospital checking on the same equipment. Staff can instead focus on identifying problem areas and resolution which in turn allows additional labor to address issues such as preventative maintenance of key equipment.

Equipment typically monitored by DDC systems in healthcare facilities include: chillers and cooling towers, boiler combustion, air handler units, distribution pumps and emergency power transfer switches.

The Problems of Proprietary Protocols

For all the benefits of DDC systems, they did no come without problems and issues. The first DDC systems available on the market were based on manufacturer-specific proprietary communications protocols. Many of these systems continue to

operate in healthcare facilities today. Such proprietary devices are often not capable of interfacing or working in conjunction with devices from a different manufacturer.

The result of this is that when a facility was initially constructed using one manufacturer's devices and is subsequently to be expanded or remodeled, there is a very strong incentive to purchase compatible new devices from the original manufacturer. The penalty of using equipment from a different manufacturer is that one ends up with two different, independent systems with staff having to be trained to operate both. This often results in some manufacturers, or their representatives, taking advantage of this diminished competition with high add-on prices and poor service. This is evidenced by the fact that it is not unusual today to see hospitals with different manufacturers' systems installed in different wings.

Another problem with proprietary DDC systems is limited integration. Few, if any, offerings integrate all the various aspects of ancillary systems such as lighting, fire, security and access control. In many instances there are gateway drivers available, however these often limit the amount and direction of information transferred between two systems. This situation makes achieving potential savings difficult due to the fact that staff must be trained in the day-to-day operation of multiple systems, working on multiple PCs, one for each system.

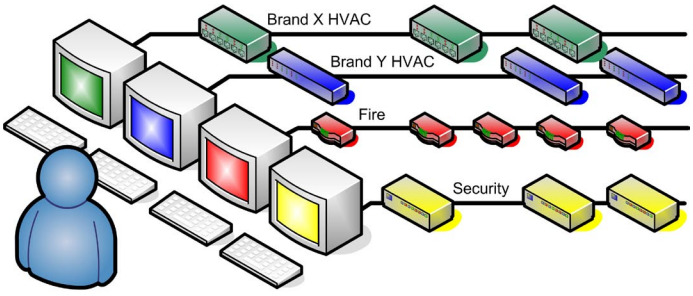

Fig.1 Poor integration with multiple proprietary DDC systems.

Holding Costs Down

The re-establishment of true competition between vendors and the path towards a more fully integrated building automation system was achieved through the development and adoption in 1995 of an open and standard communications protocol, ANSI/ASHRAE Standard 135, more commonly referred to and known as "BACnet." (BACnet is the only international standard protocol for building automation: it has been adopted as ISO standard 16484-5.)

BACnet was developed by an ASHRAE committee comprised of manufacturers, consultants, end-users and others across the industry. The primary intent of this committee was to adopt a standard that could be deployed across various building applications including: HVAC, lighting control, fire and life safety, and other ancillary building systems. It would be supported by multiple manufacturers in any particular application.

Having a single protocol that reaches across all elements of a building automation system makes it possible to contain building operating costs through more integrated systems. For example, it supports having a single point of observation for the entire system, which can be a great time-saver for the facility's operators, as well as providing a single point of diagnosis for system problems.

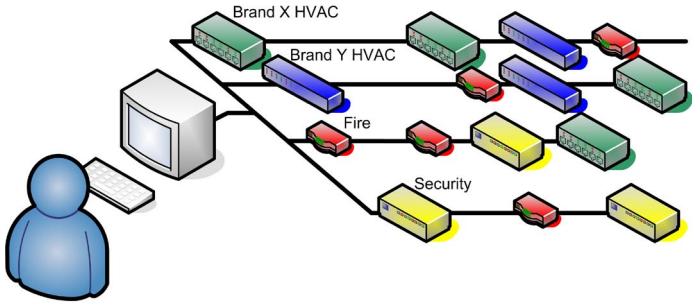

Fig.2 A single integrated system using a standard protocol

With such a protocol it becomes possible to integrate disparate systems for increased energy efficiencies and savings. For example, lighting control can be integrated with the occupancy mode (whether scheduled, manually set or automatically detected) of a room so that energy isn't wasted illuminating, heating or cooling an unoccupied room or area of the facility.

Maintaining Competition

With deployment of an open and standard protocol, competition between suppliers can now be considered in lieu of negotiated "flat" extension of existing control systems by an incumbent vendor; there is now an opportunity to solicit competitive pricing on projects. This can result in significant cost savings because one is no longer locked into the original supplier. The additional costs of outfitting the new wing of a building with a different and new manufacturer's devices, while not zero, is relatively small. And the cost difference associated with normal day-to-day operation with a mix of devices is likely to be exactly zero.

Another savings is realized through improved responsiveness from the supplier, who knows that substandard service and support could easily result in the loss of future business to a competitor.

Several years ago the City of Seattle was chafing under its dependence upon a proprietary DDC system, even though the vendor represented a solid choice for a reliable system that was relatively easy to operate and maintain. In 2003 the city's Facilities/Projects Manager discovered that the city was paying 20 to 25 percent above market price for their controls. After extensive research he qualified two BACnet vendors to bid on all future projects; this competition has resulted in a 25% reduction in bid pricing, and has also reduced the cost of associated service across the board.

Integration and Interoperation

There are many advantages to a fully integrated building system. Single seat operation of various building systems may range from scheduling to alarm management—when problems are detected in the building, a single form of responding to them—to a unified means for recording data logs for analyzing building performance and adjusting operating parameters to improve the performance. Coordination of operations across different elements of the building systems may also result in reductions of the building's energy usage when operating on emergency power generators or during times of energy utility overloads.

For healthcare facilities, there are the public safety advantages of integrating fire and HVAC systems, including more automated detection of, and response to potentially critical situations such as adjusting the HVAC system's operation to control and contain the spread of smoke during a fire, and secondary annunciation of fire, life safety and security alarms conveying more information about the situation than simply flashing alarms.

There are also the advantages of a unified point of alarming for the other areas of the building such as kitchen freezer alarms, grease hood fire detection, physical plant equipment monitoring of areas such as surgery suites, intensive care areas, isolations rooms and premature-baby units. It should be noted that the BACnet alarm system supports a different list of notification recipients for each alarm, varying the list if needed by day and time.

Managing Distributed Facilities

A fully integrated building automation system is even more critical for healthcare facilities that are not centralized, such as a hospital, but rather decentralized, such as a number of clinics spread across a city or even a wider region. A centrally managed system provides the most cost effective way to monitor all sites' systems and expedite troubleshooting, dispatching staff to sites only when needed.

Although in the past the connections to the remote sites were often done via dial-up modems, the Internet has become a much more popular means of making the connections. With the Internet the connections can be permanent, and also permits much higher data rates and data transfers than are possible via dial-up. Of course, the protocol in use must support data transfer over the Internet; some proprietary protocols support this, as does BACnet. BACnet also provides support for laptop workstations that could appear anywhere on the Internet; they do not need to be at a pre-determined Internet address.

An additional means of communicating with remote facilities via the Internet has also become popular: a device in each facility serves up web pages which provide a graphical interface to the buildings' systems. The advantage of this method is that the remote workstation needs only to have a standard browser; no special software is required.

Challenges and Trends

There is work yet to be done before healthcare facilities can attain full integration. BACnet devices supporting most areas of building automation are already available on the market, though for some applications their full functionality has yet to be attained. The BACnet committee has working groups extending application support for lighting controls, energy utility integration, CCTV control and other areas. While much of this might not be necessary for run-time healthcare facility operation (a standard command to set "Fade-out Time" for lighting control, for example), some of it is necessary for full integration in other markets. Some of these extensions will begin to roll out in the near future.

Summary

Pressures on healthcare facilities to be more cost effective in all aspects of their operations are here to stay. For the building automation systems, this means increasing integration and interoperability of what were once isolated systems: HVAC, lighting controls, fire and life safety systems, access control and so on. This integration will reduce day-to-day operation costs through better utilization of facilities staff and will provide increased savings through synergies between systems.

Through acceptance and deployment of building automation systems utilizing a standard protocol for interoperation between offerings from multiple manufacturers, healthcare facilities are afforded the opportunity to create a more comfortable, secure and well-managed environment of care. As the cost of the underlying technology continues to drop, the systems will become ever more sophisticated, providing more performance for lower cost, with greater efficiencies in energy and overall cost reduction associated with operation and maintenance of healthcare facilities.

Bill Swan is chairman of the BACnet Committee and Alerton's engineering fellow. He has served in a variety of roles relating to ASHRAE and the BACnet standard. The BACnet Committee works with ASHRAE and other industry partners to develop and maintain the BACnet communications protocol.