*BACnet is used at the University of Minnesota to centralize control over building systems.*

*BACnet® at the University of Minnesota*

# Flexibility, Interoperability

**By Terry W. Hoffmann,** Member ASHRAE

BACnet cuts the umbilical cord tethering facilities to single-vendor solutions. Just as most of today's desktop printers work seamlessly with most of today's desktop computers, any piece of BACnet compatible equipment will work with any manufacturer's building monitoring and control system. Facilities can select best of breed equipment from a variety of manufacturers to achieve the desired level of control at a competitive price. Meanwhile, interoperability is ensured.

From the 1970s through the 1990s, the University of Minnesota invested in building management systems from a single manufacturer. It purchased every generation of that manufacturer's products from the first to the fifth. As with all building management systems of their era, the systems used a proprietary data protocol to communicate with equipment.

By 2002, BACnet was a growing factor in the marketplace. Wanting greater flexibility in purchasing and more centralized command and control, the university began its migration to BACnet. Today, the university operates about 80% of its systems on BACnet and owns systems and equipment from eight vendors. The facilities management team field tests all equipment to gauge its BACnet compatibility before purchasing it.

### Centralized Command and Control

BACnet enjoys great popularity with universities, government buyers and other entities with vast multibuilding campuses. Earlier this decade, such campuses were often a hodgepodge of different vendors' systems operating on different data protocols. Facilities managers often had to monitor each building individually. Even then, they might have to keep an eye on half a dozen different monitors.

The beauty of the University's BACnet implementation is that it helps organizations centralize control over all building systems. The integrated system can be operated with single-seat monitoring

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and control for any number of BACnet subsystems across any number of buildings. The University of Minnesota's control center oversees 287,000 objects. Approximately 80,000 people visit the university each day. It is impressive to think that the common user interface can monitor and control facilities affecting so many people.

For day-to-day purposes, it matters little whether operators have 20 years or 20 days of building systems experience. A single-user interface makes it easy for novice operators to view, comprehend, and respond to alarms.

**Freedom in Purchasing**

BACnet has also helped the university's facilities management department assert control over its budget.

Becoming a top research institution requires skillful financial stewardship. Operational considerations cannot be the tail that wags the dog. The University of Minnesota's facilities management department is charged with keeping capital and operating expenses in check.

BACnet is a valuable tool helping the University of Minnesota to control costs. It gives the university flexibility in purchasing. Thanks to BACnet, the university can evaluate and purchase the best equipment for each application instead of equipment that happens to be compatible with a proprietary data protocol.

In past years, according to Dan Bellows, a building systems engineer at the school, the university would often turn to one vendor to equip an entire building. Those days are gone.

Now, the university comparison shops. Depending on circumstances, the facilities team may select the equipment with the lowest first cost, the lowest projected life-cycle costs or specific features well-suited to the university's unique demands.

**Controlling Research Environments**

Scientific research depends on precisely controlled environments. Any changes to those environments can negatively impact research.

For example, the University of Minnesota has a number of horticultural research facilities. A dramatic temperature increase or decrease could harm research plants, resulting in damaging and expensive ramifications for the research involving those plants. The experiment could be set back months or even years.

If a light does not shut off when it is supposed to in an office building, it is not the end of the world. However, if a light that is supposed to simulate sunlight in a lab shuts off, it could ruin an experiment.

Today's building systems precisely control lighting and climate systems, maintaining the specified environment for the research. If temperature drifts outside the desired range, the operator knows it immediately and can make corrections.

Other research depends on precisely controlled humidification and atmospheric pressure. The university has a growing number of clean rooms for research. Cleanrooms feature extremely low concentrations of particulate matter in their atmospheres. They generally have low humidity levels as well. Filters remove dust and other particles from air entering the room. Recirculated air passes through high-efficiency particulate air (HEPA) and ultralow penetration air (ULPA) filters to keep it clean of contaminants.

Building systems are responsible for maintaining higher atmospheric pressure inside the cleanroom than out. When a door opens, the vacuum created sucks particulate matter out of the cleanroom rather than allowing it to enter. Maintaining this sort of consistent atmospheric pressure requires constant, adaptive and highly precise tuning.

If the University of Minnesota is to become one of the world's elite institutions, it must be able to recruit the world's best researchers and attract lucrative research grants. The possibility of negative impacts on experiments due to unreliable building control systems would be more than enough to frighten off both.

With BACnet, it is easy to equip facilities with precision controls and highly reliable equipment. Lighting, temperature, humidity and pressure are maintained at the desired level, usually without human intervention, with little potential for error. The university has not experienced a catastrophic loss of research due to building system failure since BACnet was adopted.

**Five by 10: The University of Minnesota's Energy Plan**

BACnet is also helping the University of Minnesota control energy consumption. The university's "five by 10" plan calls for a 5% decrease in energy consumption by 2010. This type of plan is becoming increasingly common.

Here again, BACnet proves its worth. The university's facility managers are free to purchase energy saving systems and equipment from any number of vendors. Moreover, they have the flexibility to shop for equipment with the lowest life-cycle costs, factoring in the projected cost of energy.

BACnet also enables some interesting energy saving integrations. The University of Minnesota has plans to integrate its classroom scheduling and building management systems. When a classroom is not in use, there is little reason to keep it heated or air conditioned to occupied levels. The integration will allow the building management systems to "know" when classrooms are occupied and when they are not. It will allow temperatures in unoccupied classrooms to drift up 10 or 15 degrees in the summer and down 10 or 15 degrees in the winter for significant savings.

The classroom scheduling system integration mirrors a growing trend in office buildings and airports. Office buildings are integrating their conference room booking systems with their building management systems, allowing temperatures in unoccupied conference rooms to drift outside the comfortable range. Airports are doing the same with arrival and departure gates by integrating building controls with their flight information databases.

Bellows points out three additional applications that reduce energy consumption and depend on system integration provided by BACnet.

In many cases throughout the university, one DDC system controls the air handlers while another controls the rooms. BACnet is the common communication medium between them. The university is reducing energy use by resetting the

# Energy Conservation a Growing Concern

The Energy Efficiency Indicator (EEI) is the most comprehensive study of North American energy management practices. It is conducted annually by the International Facilities Management Association in partnership with Johnson Controls. The 2008 Energy Efficiency Indicator study surveyed 1,500 executives with direct responsibility for energy management decisions. The study revealed mounting concern over energy costs. Seventy-two percent of organizations reported they are paying more attention to energy efficiency than they were just one year ago.

This growing interest is motivated largely by concerns about energy cost. On average, respondents projected that energy prices will increase 13.25% over the next year. For an institution the size of the University of Minnesota, large annual energy price increases put formidable pressure on the bottom line.

Environmental concern has a role to play as well. University students, faculty, staff and community members are well aware of climate change and the global trend toward greener facilities. For 53% of EEI survey respondents, environmental responsibility is an equal or greater motivator for investing in energy efficiency than cost reduction. Seventeen percent cited environmental responsibility as the stronger motivator. Thirty-six percent said they were equally motivated by environmental responsibility and cost savings.

Energy decision makers are turning to technology to trim energy consumption and control energy costs. Common investments in energy efficiency include:

- Adjusting HVAC temperature controls to reduce the time that heating and air conditioning run (61%);
- Installing, updating or improving a building management system (42%);
- Replacing inefficient equipment before the end of its useful life (41%);
- Increased monitoring of energy consumption (31%); and
- Installing variable speed/frequency drives (20%).

Typically, organizations expect such investments in energy efficiency to pay for themselves within three and a half years.

duct static pressure in these buildings based on reported VAV damper positions. When any damper is 90% open, the duct static is increased. When they all drop to 60%, the duct static is decreased. Without a common protocol between these systems this energy saving strategy would not be possible.

Likewise, chillers are controlled by one vendor in many buildings while the air handlers and rooms are controlled by another DDC vendor. Using the BACnet protocol between the two allows the university to reset chilled water temperature based on cooling demand. The end result is additional energy savings.

Finally, the university is implementing a lighting control project that will allow it to control both space temperature and lighting from a single occupancy sensor. BACnet is the protocol engine between the two systems.



**Conclusion**

In a few short years, the University of Minnesota's facilities management organization has bloomed into a more efficient, forward-thinking and responsive organization. Much of that change has come thanks to strong leadership, innovative management practices and a shared sense of investment in the university's promising future.

BACnet has also had a role to play. It has allowed the university to centralize control over building systems. Purchasers can now shop from a broader array of systems and equipment. Facility managers have more latitude to save energy though systems upgrades and innovative integrations.

The results speak for themselves. Customer satisfaction with the facilities management department rose from 73% in fiscal year 2005 to 85% in fiscal year 2007. The department's operating budget has grown more slowly than its peers, while improving service and effectiveness.

The University of Minnesota is well on its way to becoming one of the world's elite research universities. This is at least in part because BACnet and the facilities management team have created an environment more conducive to leading edge research.