BACnet 20 years on

The popular IT protocol for building automation is being continually refined. Recent addenda deal with issues as diverse as load shedding, encryption, and lighting controls.

BY BRONWEN PARSONS

From its roots in North America, the building systems protocol BACnet became an ISO standard in 2003 and is gaining acceptance around the world, used in countries as far afield as Dubai and Korea. In Germany, government buildings are now required to use BACnet, while in Russia, the Moscow State Construction University recently made a BACnet training course a required part of the curriculum. The protocol is even gaining 30% acceptance in Scandinavia where the rival open system LonWorks traditionally held sway.

It is more than 20 years since the American Society of Heating Refrigerating and Air Conditioning Engineers (ASHRAE) began devising the open IT protocol to ease the communications between HVAC equipment and controls in buildings. And it is 14 years since the resulting ANSI/ASHRAE Standard 135, BACnet, A Data Communication Protocol for Building Automation and Control Networks, was actually produced.

BACnet is defined by ASHRAE as "a set of rules governing the exchange of data over a computer network." The rules are a written specification that governs "everything from what kind of cable to use, to how to form a particular request or command." The rules cover things like how to ask for the value of a temperature, define a fan operating schedule, or send a pump status alarm." While there are other IT communication protocols, BACnet is unique in being designed specifically for building automation and control equipment.


Bill Swan of ASHRAE

Since BACnet's inception ASHRAE's technical committees have worked hard to expand and improve its applications, a task which is often complex and time-consuming.

The latest version of Standard 135 was produced in 2008. It included seven addenda, and 11 more are in the process of being developed. Bill Swan, former chair, (2004-2008) of ASHRAE's BACnet Committee and vice-president of the BACnet Interest Group of Europe, says "We are making a lot of changes, or extensions, to the standard. Our pace of activity is such these days that we are putting out large numbers of addenda at the same time."

Swan, who is also the building standards initiatives leader for Honeywell and lives in Redmond, Washington, explains some key addenda that have been incorporated in the 2008 BACnet standard. He also discusses developments on the horizon that different BACnet SSPC (Standing Standard Project Committee) teams are focusing on.

Load control - talking to utilities

The brainchild of one team – the BACnet Smart Grid working group – is the load control data "object." It was added to the BACnet protocol as a standard means to configure a building's automation system to work with a utility. Should the utility be suffering from demand overload, or if the building owner wants to take advantage of off-peak energy rates, the building's energy consumption can be adjusted.

Swan explains that until now these demand control, or load shedding, exchanges have generally been arranged via a telephone call to the facility manager. "What's being done now is to automate that whole process." The building automation system can even send meter information back to the utility to verify that it did comply with the request.

With BACnet, no matter what proprietary system is installed, you can add a BACnet box, "put it in your building and you've got the capability for the system to talk to the utility."

The Smart Grid working group is also developing an

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addendum for energy trading.

Because much of the communication with the utilities will take place over the internet, security has become increasingly important. In July, the BACnet committee said they will publish an addendum to enable FIPS-compliant secure communications to be used with BACnet Web Services.

Wireless Networks

ASHRAE recently published BACnet for ZigBee wireless networks. While wireless networks are still relatively rare, Swan says that they can be useful in older buildings where it's difficult to run wiring, or in interiors where there could be lots of occupancy changes.

Applications Profiles

The task of the Applications working group is so complex they have been working on it since 1996. They are developing BACnet standard "profiles" or "macro objects" that are tailor-made for particular pieces of equipment, such as chillers and variable frequency drives. Ordinarly BACnet handles data at a more granular level, but the new profiles will represent a larger set of values. "It's been a difficult job," says Swan, "but we think that BACnet will be greatly improved by having the larger objects." The committee has almost completed a profile for variable frequency drives that will be used as a model for developing profiles for other devices.

Testing BACnet devices

Since 2003 there has been a testing standard for BACnet devices, and there are two laboratories that test equipment and authorize the BACnet Testing Laboratory (BTL) mark. Now the Testing and Interoperability working group is finding ways to make the tests much more comprehensive. The group has just achieved a milestone, having completed testing of BACnet building operator workstations. "This means we now have the capability to test all kinds of BACnet devices," says Swan.

"I always, always, always suggest that

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Cooling the Towers of Dubai

Toronto-based NORR Architects and Engineers design tall buildings in Dubai and other Persian Gulf states where the hot and humid climate hovers around 40°C for much of the year. NORR designed the signature Emirates Tower, as well as the Shangri-La Hotel, both over 48 stories in Dubai. They are also the architect of record for the Burj Dubai, the world's new tallest building, which is nearing completion.

Chris Pal, P.Eng., director of engineering for NORR in Dubai, explains that while the architecture of towers in the Gulf states is futuristic, their building systems have many of the same components as in North America or Europe.

NORR

Emirates Towers, a 150,000-sf landmark in Dubai, designed by NORR.

"Much of the technology is the same," Pal says. "Obviously we don't need heating in Dubai, and free cooling (using outside air) is not viable. The devices that we control might be a little different. But we have cooling, we have dehumidification, we have to all intents and purposes all the things we would have in North America. So the automation system itself has to be smart enough to do all the same kinds of things there as here in Canada."

Pal says that single-sourcing building automation systems isn't common in Dubai. Instead, the towers tend to use BACnet as the open protocol to harmonize different manufacturers' products. The devices themselves may have distributed intelligence, he says, "But every singer has to sing from the same songbook, so they're all reporting back to a mothership, as it were, on a BACnet compatible network."

Because the largest towers and complexes are multi-use, each occupant zone will tend to have autonomous building systems control. There might be two hotels, office space and residences all in one development. "They all want control of their own destiny," Pal explains. "A five-star hotel, for example, must react in minutes if there is an air-conditioning problem."

At the same time, those autonomous systems are all connected together " so that the building owner can monitor information such as doing energy analysis, trending, costs, etc.

Pal says that despite the steaming temperatures in Dubai, some of the older buildings are actually uncomfortably chilly inside. That's because the building systems try to make up for lack of dehumidification by excessively cooling building spaces. Dehumidifying enables temperatures to be kept a little higher, increasing comfort and saving energy costs, a factor that is becoming more important as LEED-Silver is being mandated for new buildings in a large swath of the city.

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when people specify BACnet devices, they should specify devices that have the BTL Mark," says Swan. Otherwise, "what we find is that frequently implementers make mistakes or they make improper choices, so that devices without the mark don't always work with others as well as they should."

Swan estimates that only around 30-40% of devices are currently tested in the BACnet lab and receive the BTL mark. It can cost around $5,000 to test a small controller, for example, he says.

Lighting Controls

The Lighting Applications working group is developing lighting control extensions for BACnet. This is a typical example of how addenda are initiated, says Swan. "A lighting control manufacturer sent a representative to the committee saying they wanted to do lighting in BACnet. He got representatives from other lighting control companies to come and they started hammering out what was needed."

The committee is working on standardized interfaces for controls, a task that involves "lots of complexity in not obvious ways," says Swan.

The group's work must take into account issues such as expected lamp life, dimming and fading, and new schedules for sunrise and sunset. They're also working on extensions for theatrical lighting, which can change in 100th of a second.

Access Doors

The 2008 BACnet protocol incorporates the Access Door "object" relating to controls over the physical doors of a building. Another object was added for card readers, and there are also new extensions representing the database of who is permitted inside, when and where, explains Swan. Encryption is very much needed for the security of the access control extensions, he says.

All the initiatives to expand the usability of BACnet are undertaken by volunteer experts drawn from the consulting engineering and manufacturing sectors, with employers paying for the extensive time involved to serve on the BACnet committees. "I think last year we spent 21 days in face-to-face meetings alone," says Swan. CCE

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engineers pursued the opportunity to analyze details.

When the giant structural analysis programs of the MS-DOS days were upgraded to the Windows environment, it was achieved by building the graphical user interface i.e. enabling the engineer to graphically build a 3D structural model. But this approach did not extend to the output report. The structural analysis programmers provide their own built-in routines for producing reports, and these remain today in their dreadful original MS-DOS formats.

Engineers are not trained to transfer the structural analysis results into Microsoft Word or Excel where the information can be manipulated and reduced into an accessible format for justifying the design and the calculations. Consequently, the result for every single structural member is printed out and presented as the calculation and the proof. Engineers have been drawn into the quantity, not the quality of the calculations, and as a result calculations for the analysis have become quantitative tomes of work, failing to meet the primary and fundamental requirements which are to prove the structure's stability, adequacy and reasonableness.

The calculations can become a very useful document during the lifecycle of the engineering design, from the conceptual phase through to material purchase, delivery, fabrication, transportation and construction. But it is very difficult to achieve this aim if we're waiting three months and we have 400 pages to look forward to. The quantitative approach is not practical engineering.

We, as practising and professional individuals, need to recognize how we can do better in our calculations, set a benchmark for expectations, and engender critical thinking in a world of too much information. Quality calculations are about performance, communication and teamwork. Let's start talking. CCE

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The new NVS Series of network video recorders by **Toshiba** supports 32 IP network cameras, including megapixel models. Suitable for ultra-high resolution recording with mass storage up to 4TB. www.toshiba.com

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