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This Issue

Smart Buildings and BACnet

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Cover picture

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Is Your Building Smart Like Your Phone?

… and the answer is "No"

Answering the question, "Is your building smart like your phone?" might seem problematic since the apparent answer is, "It depends." You might think the answer depends mostly on your building… what kind of controls it has, how thoroughly it was commissioned, how well it's operated. But I would argue that none of that actually makes any difference. The history of the evolution of the "phone" into the "Smart Phone" suggests we have barely started on the journey from "buildings" to "Smart Buildings"… although "journey" may be too gentle a word. If history is any guide, we may be embarked on a pretty wild adventure.

Smart Phones

In the old days (less than a decade ago) there were no Smart Phones. Instead there were just phones (now referred to as "feature phones" – presumably because devices called "dumb phones" wouldn't sell very well). Of course they were actually pretty smart because they could not only initiate and receive calls they could also tell you who was calling before you answered it, take a message for you if you chose not to answer it and give you a list of all the calls you'd ever made or received – and they could do it without wires; all great, innovative features at the time. And then along came the iPhone that offered something fundamentally different. It was still a phone but it went about many of those "phone things" in a different way and incorporated features that were not traditionally "phone" features at all. Plus it provided mechanisms to easily expand its functionality – to the point where there were soon over half-a-million apps available to extend and customize it. The iPhone and the phones that followed in its footsteps have become the definition of "Smart Phone." Thus the Smart Phone represents a radical shift in the implementation and expectation of a phone while not actually doing "the phone thing" any better. So, how does all of this relate to Smart Buildings?

Smart Buildings

It seems to me that much of the current perspective on Smart Buildings is not ambitious enough. Many things promoted as part of "Smart Buildings" today would be akin to calling the first phone with downloadable ringtones a Smart Phone. The Smart Phone was a radical shift from traditional cell phones. So we need to think radically to get to a Smart Buildings concept, too. Several technologies are coming together in building controls that will drive truly radical change. LED lighting is one, wireless communications is a second and cloud-based applications and services is a third. Think about a world where every light source is a sensor and information node in a distributed network; where you have detailed geospatial information on temperature, occupancy, light and activity with a granular level of a couple of square meters; where all of that information is gathered and stored and analyzed with virtually unlimited computing resources; where that processed information can be fed back to every light node to impact light intensity and color temperature; and where any information can be encoded in the visible light emitted from those light nodes and thus accessible to any device or sensor with line-of-sight; and where anyone can design an app that aggregates, utilizes, leverages, builds on and/or rides along with that information in either direction. That is where the infrastructure will be in ten years. That will be the platform for Smart Buildings.

Of course the platform for Smart Buildings is not the end game, but just the starting point. There are presumably a lot of applications that can be deployed on the coming platform and many have already been conceptualized and even prototyped. In fact, I have met people who believe we have already thought of most of the relevant applications. But history would say that our imagination falls far short of the innovation potential of the "crowd." So what exactly will a Smart Building look like? Well, even if I knew the answer I don't suppose I would just publish it in this column. But I will say that I am confident it will start with ubiquitous connectivity and open innovation platforms and that it will roll out in conjunction with the rapid deployment of next generation LED lighting technology… and it will be industry-changing.

Smart Companies

How industry-changing will it be? Lacking a crystal ball, let's look at history to see if we can get some idea of how dramatic the move to "Smart Buildings" as opposed to "just buildings" might be. Prior to the first Smart Phone, the world leaders in cell phone were Nokia and RIM. That was just five years ago. Today, they both struggle to remain relevant and neither one is in a leadership position. Instead, Apple and Google – neither one of which were a factor in the cell phone market six years ago – are the industry drivers. Can that happen in the building automation industry? Many people would say it can't. They would say the industry moves slowly and there is little risk of an outside player moving into a significant position because no one can do building automation better than the current industry leaders. Personally, I'm not so sure.

It's worth remembering that Smart Phones don't really perform the traditional functions of a phone any better than feature phones. In fact, many Smart Phones are significantly worse as a phone in terms of form factor, keyboard and even voice quality. But Smart Phones changed user expectations in ways that made those characteristics less important in the decision process for a large (and rapidly expanding) group of users. Will something similar happen in building automation? If so, we may find ourselves caught up in an "Automation Armageddon" where disruption in the building automation industry dwarfs anything that has come before.

Smart Companies will think long and hard about that. They will try to envision the new products and services that will comprise the Smart Building landscape. They will consider the potential impact on their current customers, suppliers and business models. And most importantly, they will recognize that they can't know all of the answers in advance so they will ensure their organization and processes are well equipped for rapid change. Smart Companies are the ones who will win in the marketplace as Smart Buildings become a reality. ■

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BACnet International

Smart Buildings Now and Tomorrow

Building owners, designers, contractors and facility managers are all trying to build new buildings or renovate existing buildings as "smart" buildings. We think of smart buildings as being innovative, using advanced technology and materials, reducing energy, sustainable, and providing more efficient, effective and progressive operations. The technical aspects of smart buildings generally involve system integration, advanced building management tools, automation, energy management, data analytics, integration with IT and many other emerging technologies.

The building industry has gone through several transformative periods. Many years ago changes in buildings were due to the invention and introduction of mechanisms and devices such as plumbing, construction cranes and elevators. The current transformation is due primarily to an intense focus on energy and sustainability, but also relentless innovations and advances in technology. With the backdrop of a global society now habituated to real-time information and communications technology, there is not only acceptance of cutting-edge technology as an integral part of our buildings, but the expectation that buildings will be smart.

Green buildings and smart buildings are complementary and may overlap a bit. However, whereas green buildings have numerous certification processes that define or shape the energy efficient and sustainable building and provide guidance to the design team, the smart building process has few. They include the Asian Institute of Intelligent Buildings (AIIB), the Building Research Establishment Ltd., the Intelligent Building Society of Korea (IBSK), the Shanghai Construction Council (SCC), the Architecture and Building Research Institute, Ministry of the Interior of Taiwan and the Smart Buildings Institute (SBI) in the USA. (http://www.smartbuildingsinstitute.org/). The SBI certification structure is similar to LEED, has prerequisites and criteria that are credit-based where applicants earn points based on the design and operation of the building. These organizations aim to shape a smart or intelligent building with the criteria they have established.

Building owners who have deployed smart building solutions have generally found value

and a very attractive return on investment (two years or less). The value the solutions provide contribute to reduced energy consumption, improved building operations and improved tenant satisfaction. An example of this is the use of analytic software to determine if a building system is performing optimally, such as the use of fault detection and diagnostics (FDD) for the HVAC system. Lawrence Berkeley Laboratories in a study on ongoing commissioning, an element of which is system diagnostics, showed an average energy savings of 10 percent and as much as 25 percent in some cases. Many of the FDD tools go beyond just identifying "faults" in building systems and can provide guidance on what the root cause of the "fault" may be. This is information that is valuable to the facility engineer and saves time. Some of these tools can also "monetize" the fault, where there is some indication of the severity of the problem or its wasted energy. The monetization of the faults tends to rearrange the priorities and urgency of work orders.

The current capabilities of a smart buildings are quite extensive:
- Multi-system integration that provides enhanced functionality for a building
- Integration of data from several building systems, business tools, facility management systems and exterior data
- Analysis of building data and the creation of metrics in order to measure and monitor building performance against benchmarks or established goals
- Advanced building management platforms with the capability to deploy real-time system analytics and do so on an enterprise basis, remotely and covering an entire portfolio of buildings

Several potential trends in smart buildings are emerging and we can expect implementation and penetration of these innovative new products and services in the near term.

What follows are some examples:

New Building Systems

One new addition for buildings we'll see in the near future is Indoor Positioning Systems (IPS). Locating assets and people within

buildings has value for potentially improving the performance of buildings, businesses and life safety. Indoor location technology is already being developed and deployed by some of the world's largest technology companies. While a number of technical approaches have potential for being the basis of indoor positioning, most approaches utilize tracking people via their smartphone. The benefit for building operations is accurately locating people during a life safety event, obtaining occupancy metrics regarding the building spaces, and determining the time and duration of occupancy information that can be used to improve both energy management and space allocation.

Greater Use of Enhanced Analytic Software

The use of fault detection and diagnostics software is currently focused on HVAC. We can expect similar analytic software will be developed for other building systems. This evolution will use real time data and rules to orchestrate systems performance. The next big leap will be analytic software that can not only identify a fault or a sub-optimal situation, but will also automatically adjust or reset the system to an optimal state; true automation.

Another new building system will be eye-tracking. Eye movement is important because what people look at and how long they look at it influences their decision-making and comprehension. Today one of the more popular approaches to eye-tracking uses video cameras sensing reflected light from the eye, an approach which is not invasive and generally inexpensive. While eye-tracking is more about commercial uses, it has applications for building design and operation. Eye-tracking can improve a building's interior design, signage, way-finding, ergonomics of manual systems controls and kiosks. With eye movement directly related to decision making, we'll start to see more use of the research in the design and operation of buildings, touching on the "visual" structure of the facility, its layout, lighting, colors and placement of objects or controls. The results will include improved productivity in commercial buildings, wellness or comfort in hospitals and enhanced learning in schools.

BACnet on Board

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Microgrids

Microgrids already have traction in the smart building industry because they have several unique and powerful advantages. First is improvement of power reliability; a microgrid with multiple generation sources offers diversity and therefore greater reliability. Microgrids also have the potential to lower or at least constrain energy costs. For example, using power from the larger grid when prices are cheaper than the microgrid or conversely, maximizing the use of the microgrid when prices from the larger grid are high. At the very least microgrids offer greater flexibility for building owners in monitoring and managing their energy costs. Microgrids can also provide a slight increase in energy efficiency because they eliminate or decrease the transmission and distribution energy losses and also have the capability to recover and use heat locally. The result is higher energy efficiency, reduced costs and increased reliability

Direct Current Infrastructure in Buildings

The argument for Direct Current (DC) infrastructure in buildings is quite compelling. Most of the devices and equipment we use operate internally on DC; many renewable energy resources generate DC; and power storage is DC. Eliminating the conversion of AC to DC will also save some energy. DC infrastructure or at least a hybrid of both AC and DC infrastructure certainly seems to make sense. Some of the implementation issues with DC can be challenging but new, innovative DC products and devices, together with education and training, will eventually provide a complete DC infrastructure.

In due course, buildings will become full of technology: walls and ceilings will be embedded with sensors; every aspect of a building's performance and use will be metered and measured; real-time information on the building will be provided to occupants and building management relevant to their particular needs; buildings will be fully interactive with the power grid; cars will be efficiently parked via conveyers and geo-spatial location systems will be deployed for every building asset and person.

Buildings are increasingly becoming smarter. If the ancient Egyptians achieved engineering excellence when constructing some of the world's iconic structures using primitive technology, our technology laden world certainly has the means and motivation to dramatically transform the spaces we live and work in. ■

The TROVIS 6600 Automation System, which is freely configurable, flexibly adapts to the tasks it faces: it can handle small systems, medium-sized buildings as well as extended properties.
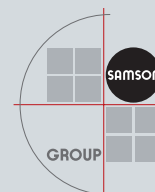
TROVIS 6600 is state of the art, both in the stand-alone version as well as in connection with partner systems using BACnet/IP. The CPU module is certified by the accredited WSPLab testing body and bears the BTL mark.

The web server integrated into the system grants access over a graphical display to all plant data anywhere and at any time.

Further sophisticated functions include remote access, data logging and alarm management.

Jim Sinopoli
PE, LEED AP, RCDD
Managing Principal
Smart Buildings LLC

SMARTBUILDINGS

A01075EN

Oh, No! It's ALIVE!
("Do we really want intelligent buildings?")

Science fiction books and films are replete with the theme. You know, when "it" becomes sentient and begins to take over the world? "It," by the way, could be a computer system, a robot, or some other "thing." And it's never a good thing – that is until the humans finally wake up, fight back, and realize that they put way too much faith in that thing.

So when the subject of smart buildings or building intelligence comes up, we might be tempted to recall Terminator-like scenes and head for the hills in fear.

Well, okay, maybe not. But it is a good time to consider what we are really trying to achieve. After all, the facility should work for us, not the other way around. Let's see if we can't give our facilities just the right amount of smarts.

I like to think of building intelligence as represented by X, Y, and Z axes in space. These axes represent the elements that are essential to building intelligence (BI). Let's refer to the X-axis as "Automation." Let's call the Y-axis, "Integration." And, the Z-axis will represent "Data Analytics & Visualization."

Now, imagine these axes forming an infinite cube. Near the intersection of the axes, where all three elements are low, building intelligence (BI) is also low. But as we make progress on any axis, BI improves. When we have a high amount of all three elements, BI is at its zenith.

The low hanging fruit here is Automation. By simply automating any of your building systems, you gain efficiencies, lower costs, and begin to capture data. As we then bring various systems together (integration) our efficiencies are increased, our costs can be lowered, and our data more valuable. After all, who wants to log into 15 different systems just to get a handle on the operation of their building?

What systems can be automated and integrated? Certainly all of the standard systems are eligible (heating/cooling, ventilation, lighting, access, fire/life safety). But then consider unconventional ones like fenestration, renewable energy sources, elevators, mass
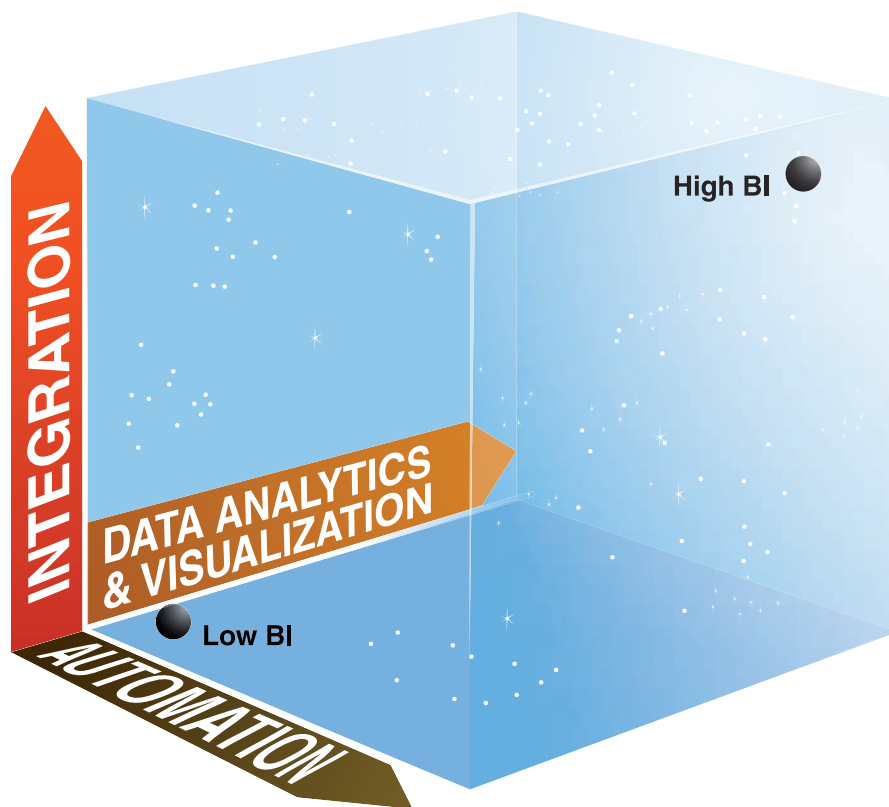
notification, emergency power, or even garage parking.

BACnet control is your ticket to achieving automation of any such system and the integration of various systems. It is the de facto standard for building system communications.

Now, because data is so vital to your facility operations today, the third axis deserves some attention. Your building automation and control system is capable of collecting, trending, logging, and displaying a tremendous amount of data. Further, BACnet can do so predictably and reliably.

But there are also third party approaches and bolt-on packages out there that can help you make better sense of all this data. Together these data analytics and associated data visualization packages make for better management and higher building intelligence, especially across a portfolio of properties.

So, I say push the limits along these three axes and get the smartest building on the block. And should your facility ever become self-aware... well, you can always head for the hills. ∎

Ben H. Dorsey III
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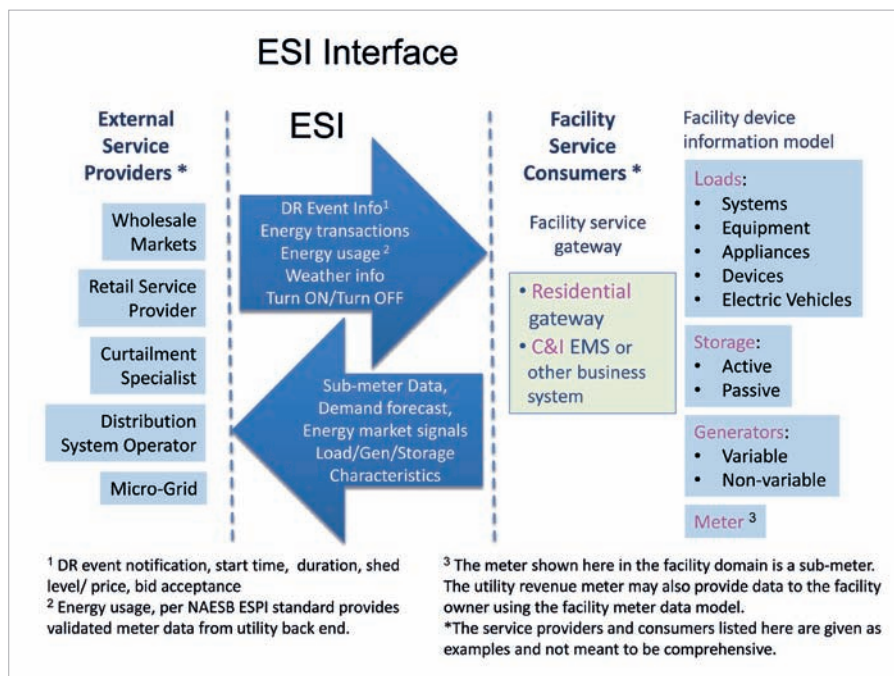# Getting your Building SmartGrid Ready with BACnet

Figure 1; Source: NIST

This article is one in a series of articles on preparing for the coming SmartGrid infrastructure that is happening around the world. As the title suggests this article will outline what commercial and industrial facility owners and managers can do now to prepare their facilities to be SmartGrid Ready with BACnet. We will focus on existing buildings as this has and will continue to represent the majority of buildings for the next 30 years. Of course, the tips outlined in this article can be easily applied to new construction or major renovations.

The SmartGrid Defined

Wikipedia defines the SmartGrid as a modernized electrical grid that uses information and communications technology to gather and act on information, such as information about the behaviors of suppliers and consumers, in an automated fashion to improve the efficiency, reliability, economics, and sustainability of the production and distribution of electricity.

The Electrical Grid Of The Past

The electrical grid used to consist of large power plants using coal, nuclear, hydro electricity and other sources to produce electricity. Electricity was sold at fixed rates. It was plentiful and cheap. In fact the more you used, the less you paid. Large public and private sector utilities controlled the distribution of electricity to the customer.

While interruptible service arrangements were always available, this was generally only available to large users who had the ability to curtail consumption or to start diesel generators or other power sources to replace the short term power disruptions. Some utilities also offered peak and off-peak rates for electricity. If a customer had both a gas or propane fired boiler plant and an electric boiler plant, he could run the electric boiler plant at night when rates were lower.

There was no real time communications between the producer and the consumers. Power outages and price changes were transmitted from the producer to the consumer by conventional means (i. e., phone, fax, email).

Today's SmartGrid

The SmartGrid has dramatically changed the traditional electrical grid operation. The figure 1 shows the relationship between the producer

(the External Service Provider) and the Consumer. In this model, External Service Providers provide information about impending Demand Response (DR) events such as real time price changes or potential outages to the Facility Service Consumer. The Consumer can then choose to accept the price increase or to curtail consumption (e. g., dimming lights, raising the chiller plant setpoint from say 42 deg F to 46 deg F, running diesel generators to produce power on site) during the DR event. The Consumer can also provide information to the External Service Provider about the actions taken.

Nowadays, the electrical supply grids include other power production options including wind and solar power. While there is normally only one connection to the facility, customers can negotiate with different suppliers who have access to the distribution system for bulk buying of electricity. Customers with internal power production capability can now make arrangements with utilities to sell excess power back to the grid. It must be clean power and there are specific requirements for 60 Hz frequency matching so dirty power is not dumped onto the grid. Customers selling power back to the grid will become more commonplace as the SmartGrid is implemented.

BACnet's Focus is on the Facility Domain Devices and Systems

The focus of this article is on the right hand side of the previous figure 1. The Facility side is called the Facility Domain. This is because BACnet's strength is in the facility. There are BACnet-compliant devices and systems that control the building loads, monitor and control active and passive solar devices as well as generators. There are BACnet electric, gas, water and propane meters available on the market.

BACnet is not used as the communications protocol on the Grid side. It is also highly unlikely that Service Providers will have direct control over BACnet devices in the commercial and industrial Facility Domain. As a result, BAS vendors and other software suppliers will develop Energy Services Interface (ESI) gateways that will communicate between the

The SmartGrid design intent is that each physical device in a Facility is represented as an object with properties.
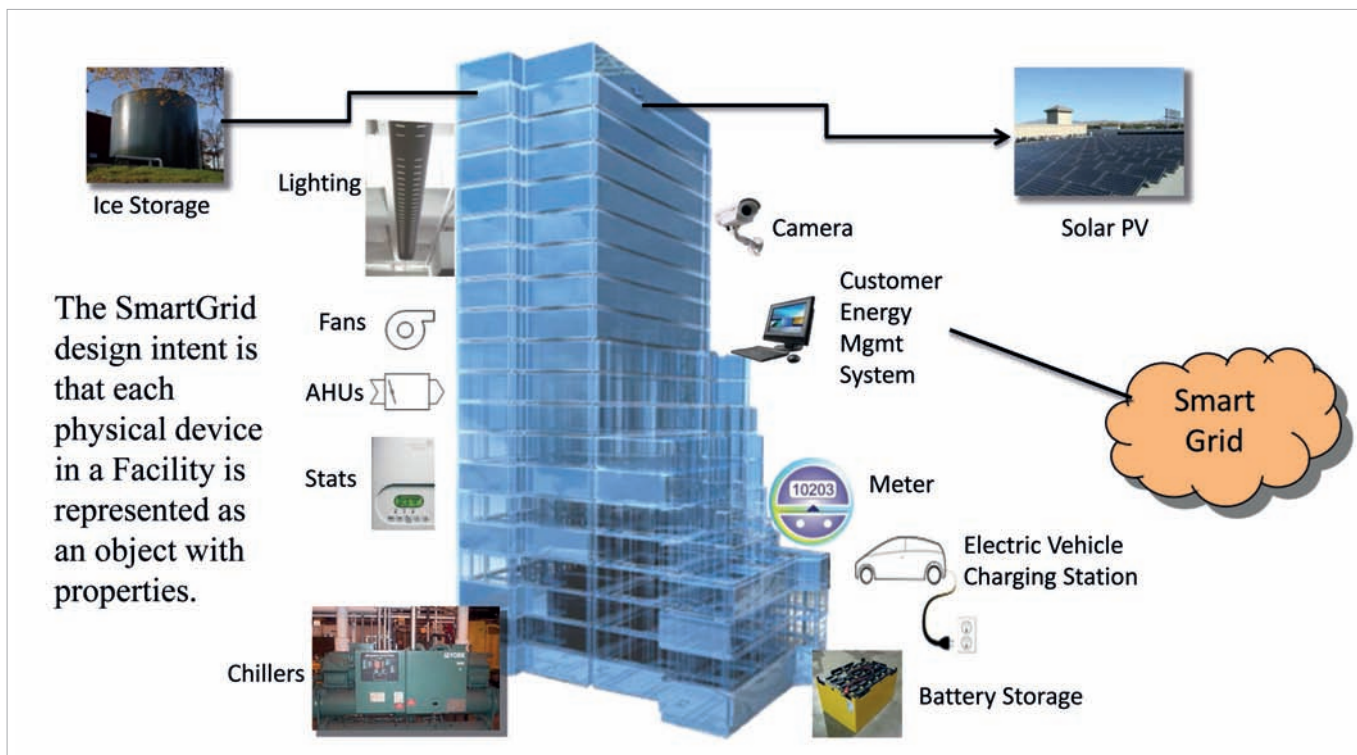
Figure 2 shows a typical building in the Facility Domain. The Facility Domain can be a single building or it can be a campus, a military base, a school district or some other collection of buildings. When you look at the equipment in this building all of the equipment shown can come as native BACnet devices or there can be gateways to these devices.   Source: NIST

BACnet devices in the Facility Domain and the Energy Service Providers on the Grid side. The big blue arrows show the data that will flow between the two sides.

ASHRAE has a developed a proposed standard 201P called the Facility SmartGrid Information Model (FSGIM). Typical devices are modelled as Loads (L), Meters (M), Energy Mangers (EMs) and Generators (G). This standard is protocol neutral. BACnet will have a representation of each device.

A Load can be a fan or a light. A Meter can be the building utility meter or a BACnet object that records kWh in a Variable Frequency Drive (VFD). A Generator can be a solar PV array or an ice storage plant. One makes electricity directly. The other "makes" thermal energy which in turn allows a chiller to run less.

In sum, virtually every energy consuming or producing device in the Facility Domain can be a BACnet device. In fact many of the devices in any building already communicate via BACnet.

### Tips for Making your Facility SmartGrid Ready

Buildings are in a constant state of renovation and upgrading. Here are some tips for how we can leverage this existing BACnet-based infra-

structure to make buildings SmartGrid Ready when such renovations and upgrades are being contemplated.

1. **Any new devices or systems added to the Facility Domain need to be BACnet compliant.** This should be self evident but there are many devices in the electrical world that do not speak BACnet natively yet. These include generators, electrical meters, switchgear, etc. Generally these devices speak Modbus – a communications proto-

col that is common in the electrical world. Eventually many of the electrical equipment suppliers will provide native BACnet devices. The good news is that there are many good Modbus to BACnet gateways that can be added to the device to make the device or system communicate via BACnet.

2. **Be careful of proprietary top down software solutions from vendors who want to take total control of your facility devices and systems.** BACnet is the pro-
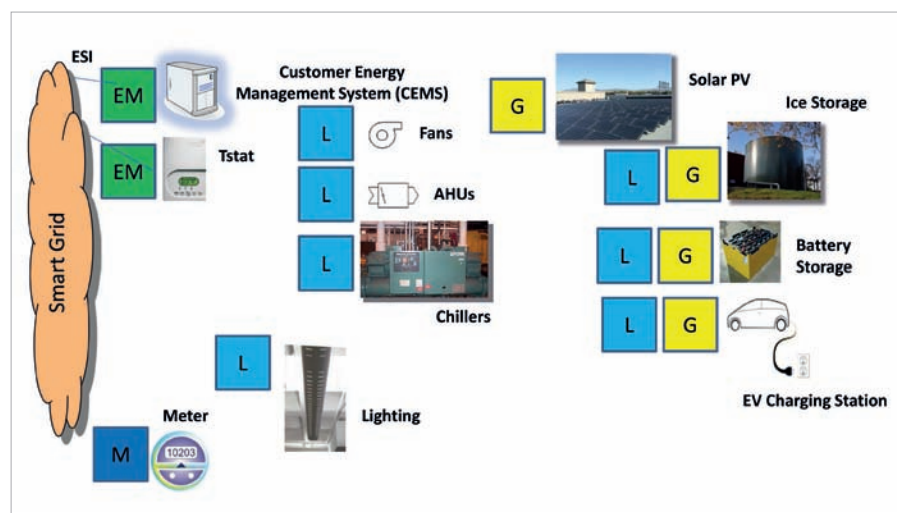
The Figure 3 shows that an Energy Manager can be a simple thermostat or a piece of software that controls all the equipment in the building. Source: NIST

tocol of choice for devices and systems in the Facility Domain. But BACnet does not yet have an interoperable solution to allow all these devices and systems to respond in a holistic manner to a SmartGrid Demand Response event following the ASHRAE 201P FSGIM standard.

The BACnet committee is planning on extending the BACnet protocol to allow for interoperable communications among Facility Domain devices that follow ASHRAE 201P FSGIM standard. Once this solution is part of the SSPC 135 standard, facility owners and managers will be able to purchase BACnet-compliant devices and systems on a competitive basis that will respond to Demand Response events to meet SmartGrid objectives.

Buying a proprietary software solution will mean that there will be the need for gateways and for reliance on one supplier when extending the SmartGrid device and system infrastructure in the Facility Domain. Until the BACnet-based interoperable solution is available, facility owners and managers should focus on upgrading equipment in the Facility Domain rather than buying proprietary software.

3. **Any new devices and systems need to have onboard energy metering via BACnet.** Virtually every VFD has the capability of providing kW and kWh as BACnet objects. This allows for very granular metering of fans, lights and other devices via BACnet.

The graphic below shows how a device can report kWh and how this data can be trended using a BACnet trendlog in a BACnet Front End. Buying devices with BACnet metering onboard means that there is no need to add in separate submeters, rather one can upgrade the building trip units and circuit breakers to provide branch feeder metering instead of installing a stand-alone submeter. These devices allow permit the monitoring of power quality as well as demand and consumption.

Digital Addressable Lighting Interface (DALI) ballasts provide kW and kWh data down to each ballast. When combined with daylighting and occupancy sensors a networked lighting system can show the real time energy and demand savings of daylighting and occupancy control strategies. If the lighting and HVAC systems are both BACnet based, the occupancy data can be shared so when the lights are off because the occupancy sensor determines that the space is unoccupied, the VAV box can run at its minimum position to save on fan, cooling/heating coil energy.

Note that these meters are not usually Revenue Grade meters like the building utility meter. They are not used for billing purposes. These meters will give a reasonably accurate value for the consumption of electricity for a fan or AHU. This data can be trended via BACnet or exported to other software for detailed analysis. This granular meter data allows a facility owner or manager to track and then compare electrical consumption between fan systems. Poorly performing systems can then be optimized to save energy. This should be done regardless of whether the building is connected to the SmartGrid or not.

One can also install flow and other meters that speak BACnet to allow for calculating real time metrics like kW/ton in a chiller plant. This is shown in the Figure below.

Besides saving energy having devices with onboard metering will assist with obtaining points for buildings where management wants the building to qualify for credits for LEED, Green Globes and other facility rating systems.

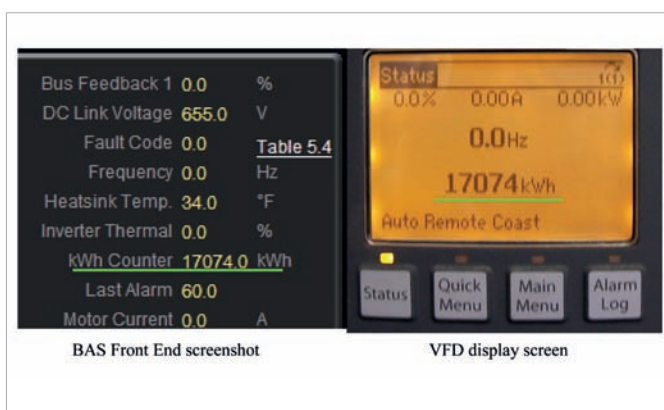4. **Use a BACnet-based Energy Dashboard to collect, organize and present utility information.** Mr. Wichenko described the benefits of a BACnet-based Energy Dashboard in **BACnet Foundations Issue 2.** Facility Owners and Managers need to put utility meter and BACnet meter data into an Energy Dashboard so it can be used to determine how electricity, gas, water, propane, etc. is being used. It may be that not all meters are electronically monitored. Some Energy Dashboards allow for manual entry of meter data from the utility bills. This manual entry can be done if funds are not available to hook up the meter to the BACnet device network.

The Figure below shows the benefits of daily metering. This building is normally closed on weekends. The BAS showed that there was a leaky tap in the building that wasted 3011 gallons of water.
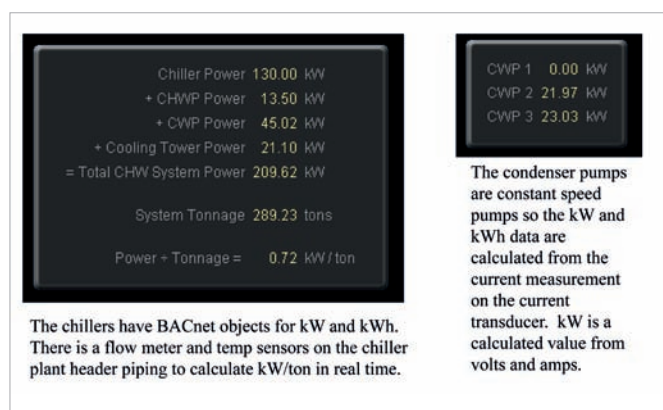
This data can be display on a TV screen in the building lobby or other prominent place so visitors and staff can see how well the building is meeting Enterprise-wide green and sustainability strategies.

5. **Install devices that allow for variability.** In the past motors were stopped and started. Lights could only be turned on or off. There was limited turndown on the boiler firing rate and boilers had to run above 140 F to prevent flue gas condensation. Chillers had the best kW/ton at 100 % operation.
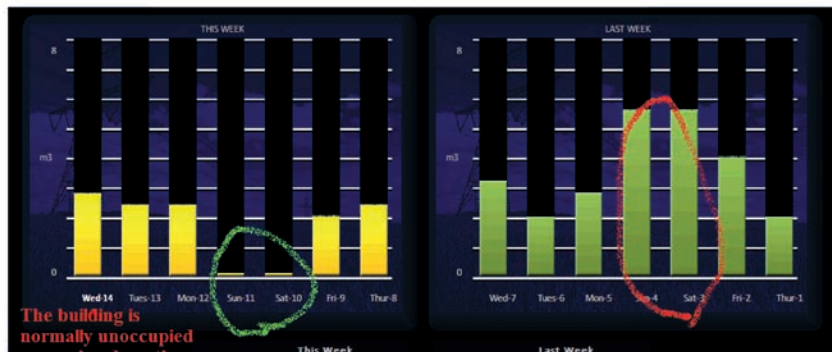
Now VFDs are relatively inexpensive and are very reliable. VFDs are now installed on motors under 5 HP. Certain jurisdictions such as some electrical utilities and State Energy Departments, offer subsidies to ins-

BAS Front End screenshot   VFD display screen

The chillers have BACnet objects for kW and kWh. There is a flow meter and temp sensors on the chiller plant header piping to calculate kW/ton in real time.

The condenser pumps are constant speed pumps so the kW and kWh data are calculated from the current measurement on the current transducer. kW is a calculated value from volts and amps.

Source: Appin Associates   Source: Appin Associates

Source: Appin Associates

The Graph on the left shows that there was no water consumption on Saturday and Sunday. The Graph on the right shows that there was a leaky tap that ran all weekend and wasted 3011 gallons. Daily monitoring will catch part of this waste.

tall VFDs. Dimmable electronically controlled light ballasts or LED lights are now available. Condensing boilers can now run between 70 and 200 deg F. Modern magnetic bearing chillers are most efficient between 20 and 60 %.

What this means from a SmartGrid perspective is that facility owners and managers, when faced with a Demand Response event, can slow down motors, dim lights reduce boiler temperatures or modulate chillers to save electricity and natural gas until the DR event passes. It is likely that most building occupants will likely not be affected by such

short term actions. They will appreciate that energy costs are being saved and will put up with minor inconveniences. Once BACnet has a SmartGrid solutions Facility Domain Facility owners and managers can also set shedding priorities so critical facilities like

data centers would be exempt from such demand management strategies.

BACnet is the Solution for Facility Domain SmartGrid Readiness

In sum, BACnet has provided a means for devices within the Facility Domain to communicate in an interoperable manner. This article gives guidance to facility owners and managers on how to get a building ready for the SmartGrid. Readers are also referred to the ASHRAE November 2013 BACnet Today supplement for other articles on BACnet and the SmartGrid.

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BACnet International Educational Committee

About BACnet International

BACnet is an industry association that facilitates the successful use of the BACnet protocol in building automation and control systems through interoperability testing, educational programs and promotional activities. The BACnet standard was developed by the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) and has been made publicly available so that manufacturers can create interoperable systems of products. BACnet International complements the work of the ASHRAE standards committee and BACnet-related interest groups around the world. BACnet International members include building owners, consulting engineers and facility managers, as well as companies involved in the design, manufacturing, installation, commissioning and maintenance of control equipment that uses BACnet for communication. For more information, please visit www.bacnetinternational.org.

The Bullitt Center
Seattle, Washington, United States

Earth Day 2013 served as a backdrop for the official opening of a new facility, billed as the world's "greenest" and most energy efficient office building. A property owned by the nonprofit Bullitt Foundation, The Bullitt Center in Seattle, Washington, is a six-story, 50,000 square foot, $18.5 million office building located at the heart of the Central and Capitol Hill district intersection.

Nestled alongside commercial offices and apartments, The Bullitt Center is a chic commercial lease space unlike any other. The building incorporates so many state-of-the-art environmental and sustainability features that new city ordinances had to be drafted to accommodate them. The goal of the project is to demonstrate the possibility of a truly net-zero, self-sustaining design.

The facility was officially opened with all the pomp and circumstance one would expect for a project boasting many impressive "firsts" for a green site in the United States. The Bullitt Center is the first commercial office building in the U.S. to meet the requirements of the international Living Building Challenge (certification pending) and the first to collect rainwater and process it on-site for potable water use. Other notable features include an efficient, low-leakage shell, large windows, responsibly sourced FSC wood products and on-site waste processing.

The Seattle architectural firm, The Miller Hull Partnership, provided design and architecture, renowned builder, Schuchart, was chosen as the project's general contractor, and PAE Consulting Engineers designed the electromechanical system. The cutting-edge environmental and energy-saving features of the structure are controlled by a KMC Controls BACnet DDC system and monitored by a KMC TotalControl software workstation.

Installed by KMC Controls Northwest Automation of Tonasket, Washington, and spearheaded by controls engineer Roger Norman, the uniquely designed controls system integrates many more innovations than most typical building automation systems. At the Bullitt Center, KMC BACnet Building Controllers and FlexStats are used for control of radiant floor heating and cooling zones. KMC FlexStats are also used for indoor air quality management and to provide free cooling.

The top-shelf equipment list includes an AAON 100 % outside air rooftop air handling unit with heat recovery, Titus VAV boxes, and Florida Heat Pump / Bosch heat pumps sourced by 26 ground thermal wells – which also generate heat for domestic water in addition to heating and cooling process water.

Some of the most impressive applications of the devices include control of rainwater collection, filtration, and purification into potable water from a 56,000-gallon underground cistern, grey water collection, control, pumping, and distribution to the building's green garden areas. KMC control devices also allow for precise control of the facility's "smart" windows which automatically open when outside air and weather conditions are favorable, or whenever free cooling is desired.

The building additionally boasts a 14,000 square foot rooftop photovoltaic solar array to produce the equivalent of the building's energy needs, an innovative floor plan designed to position all work areas within 30 feet of windows, composting toilets for on-site sewage processing, amenities to encourage bicycling, and an indoor environment free from toxic fumes generated by certain furniture or paints. In fact, the facility is so energy-efficient that simple plug-in devices such as computers, printers, and appliances are expected to account for nearly half of the building's real energy consumption. To cut down on non-point source pollution and storm water runoff, the Bullitt Center's landscape features a green roof and planting strip, as well as pervious hardscapes to allow rainwater to penetrate the soil surrounding the building.

The Bullitt Center's energy performance metrics are displayed in an educational format for tenants and visitors on a real-time Tridium JACE dashboard via a large touch-screen interface. This is just one example which helps achieve the project's stated goal of acting as an educational platform to promote replication of energy-efficient, performance-based buildings. To that end, the Bullitt Center team is working hard to share the lessons they've learned over the course of the Bullitt Center project to encourage others in the green building arena. Indeed, the Bullitt Center is a very good example from which to learn. ■

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Xerox Joseph C. Wilson Center Webster, NY, United States

The Xerox Joseph C. Wilson Center for Technology in Webster, NY, houses some of the company's global research, engineering, manufacturing and distribution operations. The campus encompasses nearly 5M square feet and 42 buildings, and is home to approximately 5,000 employees. Xerox needed to upgrade the Wilson Center to make it more efficient in terms of the manpower required to maintain the building controls, provide comfort for building occupants, and to comply with the company's greenhouse gas initiative. When Xerox began its upgrade in 2005, its annual energy spend was roughly $24M and it was projected to be at $26M by 2008, so the company also sought a better way to monitor its enormous energy consumption.

The Xerox campus hosted multiple independent control systems operating several different components in building systems that were not centrally visible. The independence of these systems made troubleshooting and system analysis extremely difficult. The vision was to create a building enterprise control system that seamlessly integrated all these components and provide access and visibility to the operations group anywhere on campus.

Xerox had four objectives for its new building controls system. First, it had to leverage the existing technology. It also had to be based on an open communications protocol that could integrate old and new equipment. The new system had to be scalable across the enterprise, and it had to safely integrate with Xerox's existing IT security systems.

VSEnergy, a Washington, PA-based energy control and integration firm, undertook a needs assessment for Xerox in preparation for an open system integration RFP and to facilitate the installation of the pilot project. At the end of its assessment, VSEnergy recommended the use of BACnet-based integration. Following evaluation of all the proposed packages, the VSEnergy and Xerox panel selected a native BACnet system from Alerton, installed by Syracuse, NY-based PASCO Building Automation Systems.

Xerox first installed Alerton's BACnet-based global controllers in each building on campus, esta-

blishing network communications that were visible at the front end. When necessary, Xerox replaced various unitary controllers with BACnet versions. Once these unitary controllers were networked to the global controllers, the buildings quickly came online.

Xerox also installed Alerton software that enabled the building staff access to their BACnet-based equipment using a standard Web browser. The software provide Web pages that show real-time data from the BACnet network and enable the Xerox staff to securely view all the building data over the Xerox LAN and make any modifications to devices.

While Xerox replaced many devices, it integrated a great deal of existing equipment as well. Technicians tied in equipment from Liebert, Honeywell, Square D, York, Carrier, ABB, Atlas Copco, Elliott, NALOC, and GE Fanuc. To date, the BACnet BAS controls more than 27,000 points across the Xerox campus.

By integrating the different equipment into one BACnet-based system and centralizing buil-

ding operations, Xerox now has unprecedented control over its entire campus. The programming now in place – demand control ventilation, occupied/unoccupied, load shedding, optimum start – enables Xerox to supply heating and cooling only when occupied areas require it, and to cycle down its operations when areas are unoccupied or unused. So far, the Alerton system has resulted in substantial energy and cost savings. ■

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Panorama E² at Lille Metropole Stadium

The Lille Metropole Stadium in France, inaugurated August 17 2012, chose Panorama E² to manage and control the stadium's entire FM/BMS system. The Eiffage Group was responsible for the construction of the Lille Metropole Stadium as part of a public-private partnership (PPP) with the Metropolitan Lille Regional Municipality.

Choosing a SCADA solution

Eiffage Energie, part of Eiffage group, selected the Panorama E² SCADA system to manage the stadium's Facilities Management (FM) and Building Management System (BMS). The Panorama E² platform, the European market leader, proved to be a reliable, ergonomic, and easy-to-use solution. It is intuitive to use with an easy-to-learn graphic editor. Furthermore, Panorama E² greatly reduces development lead times – a key benefit from a financial standpoint, and crucial in order to meet the project's tight deadlines. "Panorama's key advantage is its object-oriented development solution. Once you have created a component, you can easily model it and instantiate it directly. This
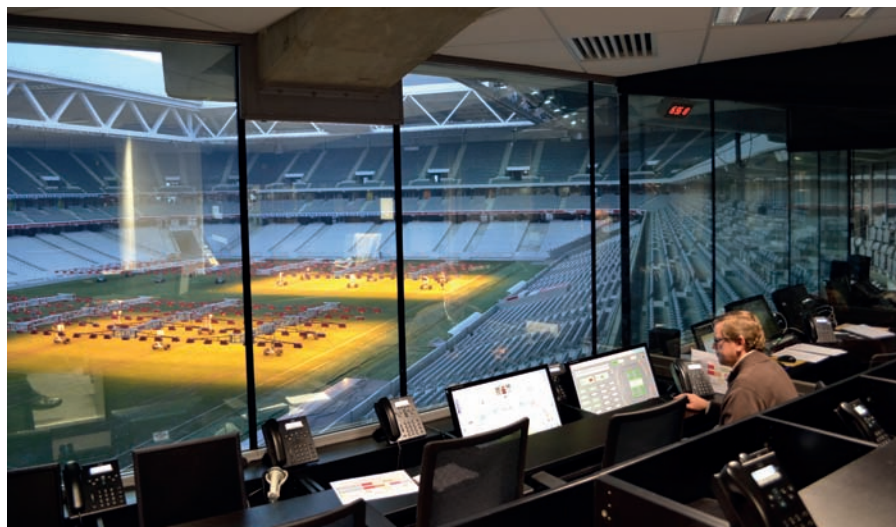
greatly reduces the time required to develop the current application, as well as future applications," said Nathanaël Morelle, FM-BMS Research Manager. "These are 'real' technical objects, unlike the other solutions which only provide graphics".

Panorama E² manages the redundancy, and can natively handle 12 redundant servers simultaneously, distribute the workload, and anticipate failure scenarios. The stadium is currently managed

with two redundant servers for the East and West sections of the building; they communicate using the BACnet protocol.

Panorama E²: Manage your BACnet network in all situations

BACnet is an open and international communications protocol used by more than 500 FM-BMS manufacturers or vendors today.
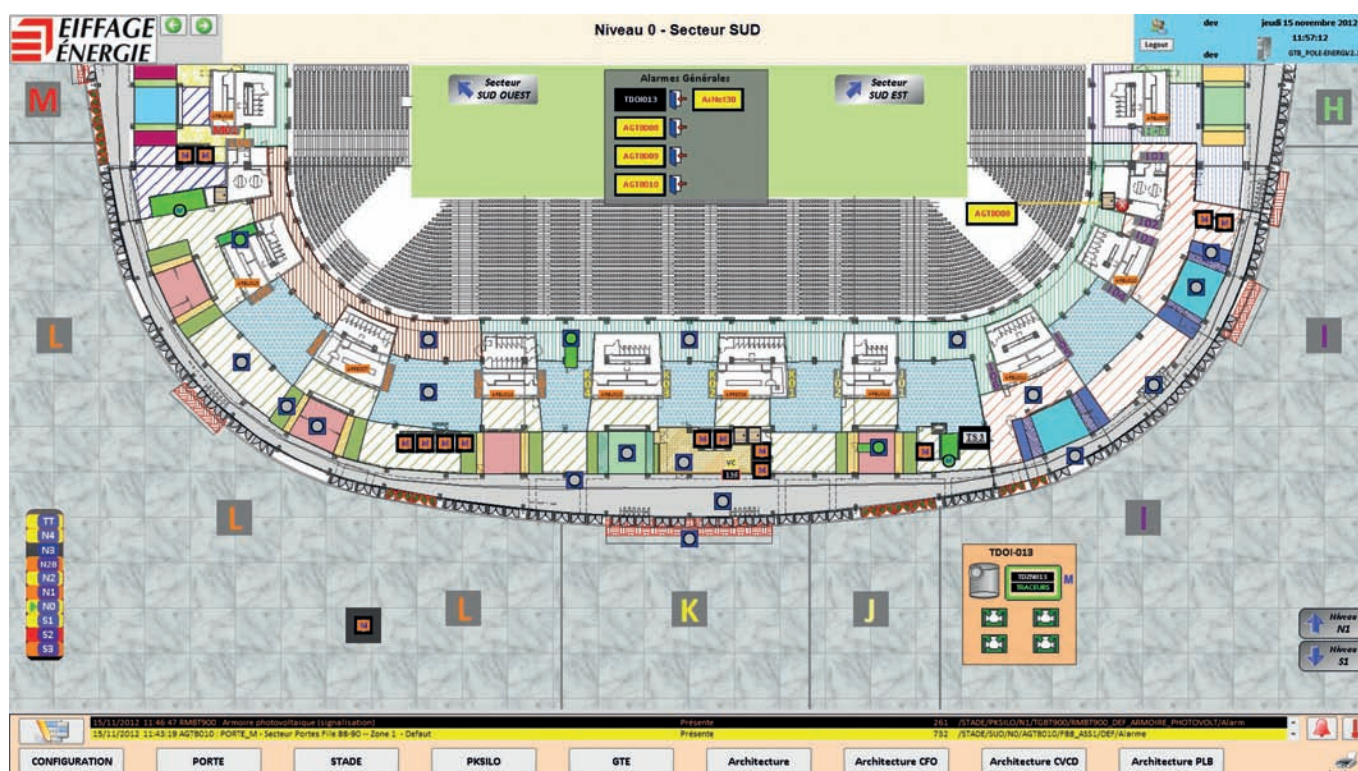
The object-oriented protocol philosophy fit perfectly with Panorama E². A BACnet object, an analog value for instance, is directly linked with a Panorama E² component. Each BACnet object property is automatically linked to a Panorama E² object property (eg "present value") and the corresponding HMI (display, bar graph ...).

All standard objects and services of the BACnet specification (including alarms and event services) were taken into account by Codra for the development of the BACnet functionality, natively integrated into Panorama E². To simplify network administration, Panorama E² can address equipments by their IP address or by their device ID. Codra also provides a BACnet library and a generic application with ready-to-use BACnet objects views, alarms display and archiving, historical datas and trends. It is thus possible to generate a complete application only by a simple network discovery or by EDE files importer.

Complementing the openness of the BACnet protocol, Panorama E² gives the possibility to add properties to standard objects or create manufacturer specific objects.

Panorama SCADA & Reporting

For the Lille Metropole Stadium Project, the Panorama E² solution manages the electricity, temperature control, fire safety, video surveillance, the IT network, the LV/HV supplies, etc. It displays the entire installation, device by device, grouped into six different zones.

Supervision is accessible from any workstation: Maintenance, Control Center (the stadium's nerve center during a match), Energy, Administrative Services, etc. Furthermore, technicians use tablets to access the SCADA system when working on site.

Due to the project's magnitude, custom processing was required for managing energy, water, and waste; it called for a powerful energy efficiency solution such as Panorama IT, Codra's

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reporting solution. Panorama IT was selected to provide information on the stadium's power consumption. The software continuously updates a database and analyses the stadium's cost for each workstation.

The level of integration of BACnet in Panorama E² and the success of major projects such as the Lille Metropole Stadium or the City of Bordeaux Centralized Hypervision made of Panorama E² an industrial standard for all BACnet projects.

SCADA, Telemetry, MES, Process automation, Panorama is a genuine communication platform, supervising plants with high availability and security constraints as well as very simple systems. Providing industrial solutions since 27 years (FM-BMS, Water, Energy, Transportation, Pharmaceuticals, Process control, Food, Oil and Gas, Safety/Security, etc…) and with more than 22 000 licences already deployed, Panorama from Codra is a leader in the SCADA market. ■

//Codra

2013 Has Been a Great Year for BTL Listed Products

Nearly 375 products have now obtained the BTL Listing. We look forward to more milestones in the years to come! This year through testing, the following vendors' devices have earned the right to display the BTL Mark.

The BTL Listing is a testimonial that the product was subjected to rigorous verification by testing, demonstrating that it correctly implements interoperable BACnet. That requirement is steadily becoming the benchmark stated in project specifications, to avoid sub-standard implementations. The BTL Mark is permitted to be displayed on devices which have passed BTL Testing. Testing ensures that a device correctly implements all of the BACnet functionality that it contains. ASHRAE standard 135.1–2011 and the BTL Test Plan governs the testing. There are three documents required to be filled out and mailed/emailed to <btl-manager@BACnetinternational.org> in order to make application for testing and commence the testing process. Fillable forms and instructions describing the entire testing process are in the 12.0 test package, at www.BACnetinternational.org/associations/8066/files/BTL_Test_Package_12.0.final.zip. The BTL Checklist and BTL Testing Application determine the testing which will be performed. Every device is different, but a schedule estimate and testcase can be created from those two documents. A signed BTL Testing Agrmt and US $1,000 deposit secures a place in the test queue. BACnet International member companies at Silver level or higher receive a discount on testing fees. It is common for testing and a Listing to apply to a family of devices that share underlying BACnet software. We test only the BACnet functionality. If the same firmware is used in common amongst devices, one testing and one Listing can apply to the family. If you have any further questions please do not hesitate to ask. I look forward to seeing your application for BTL testing. ∎

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BTL Manager
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AB Regin
- Regio Room Controllers

Acutherm
- EF-B

ALC
- LGR Line
- SE Line
- Room Controller
- ZN341v
- WebZone

Azbil
- Infilex™ VC VAV Controller with Actuator

Carrier
- AppController
- Fan Coil Open
- i-Vu Open Router
- i-Vu Open Link
- RTU Open
- RTU-MP
- UC Open Controller
- UC Open XP
- UPC Open
- Unit Vent Open
- VAV Single Duct
- VAV Fan Terminal
- VVT Bypass
- VVT Zone Controller
- WSHP Open
- WSHPW2WM Open

Continental Control Systems
- WattNode BACnet

Cristal Controls Ltd.
- CCLP-BACnet

Danfoss
- FC 102

Delta Controls
- Application Controller DAC-633PoE
- Application Controller DVC-V322PoE
- enteliZone
- ORCAview 3.40

E-Mon
- BAS Meter

Honeywell
- 961 series BACnet Thermostat Driver
- ComfortPoint™ Open Compact VAV
- ComfortPoint™ Open Digital I/O Controller

Johnson Controls
- Advanced Application Controller
- Advanced Programmable Application Controller
- Metasys
- VAV Modular Assemblies
- VMA 1630

KMC Controls
- AppStat
- Lennox BAC-8304-56

Korea Digital Control
- SCAFA ezHMI

LG Electronics
- PQNFB17C1

MR Engineering
- eBCON
- ORCAview

Obvius
- AcquiSuite

OEMCtrl
- I/O Zone 560, 483
- I/O Zone 8112
- OEMPrtl Pro

Price
- Healthcare Controls

Samsung SDS
- I/O Extension Modules

Samsung Techwin
- Network Gateway Controller SAG-B1280A

Schneider Electric
- I/A Series® MicroNet™ Unitary Controller
- iEM3000 Series Energy Meter
- SERPBC600
- StruxureWare Building Operation Automation Server
- StruxureWare Building Operation Enterprise Server

- StruxureWare Building Automation Operation Server
- StruxureWare Building Automation Enterprise Server

Siemens
- DESIGO INSIGHT

Strato
- BACwALL
- BACzone

Swegon
- GOLD IQnomic

Tekmar
- Mixed Plant Boiler Stager

Trend
- IQeco

Tridium
- 961 series BACnet Thermostat Driver
- JACE-2, JACE-6, JACE-7
- JACE-NXT

Wattmaster
- VCGX Controller
- VCBX Controller
- PCIM Controller

Yaskawa
- SI-B3
- Z1000

New to the BACnet International Family

Member of BACnet International

BACnet International is the global organization that encourages the successful application of BACnet through interoperability testing, educational programs and promotional activities. BACnet International complements the work of other BACnet-related groups whose charters limit their commercial activities.

BACnet International community membership includes a who's who list of top tier companies and industry professionals involved in the design, manufacturing, installation, commissioning and maintenance of control and other equipment that use BACnet for communication.

We are pleased to congratulate Nara and LG for upgrading their membership level to Gold.

We are also proud to have welcomed the following new members to our ranks in 2013:

Delta Group

Delta Group is the global leader in power and thermal management solutions. In recent years Delta has transformed from a product provider toward a solution provider and our businesses now encompass power electronics, energy management, and smart green life. Delta's brand promise "Smarter. Greener. Together." encourages the development and broad application of smart, energy-efficient solutions.

Delta Group
Taiwan
Gold Member of BACnet International
www.deltaww.com/

DENT Instruments

DENT Instruments designs and manufactures data loggers and energy recorders for today's energy professionals. For over 25 years, DENT has built a reputation for providing instruments of the highest quality whose robust design, small size and remote data acquisition make them the loggers of choice for companies large and small. Since the company's emergence in 1988, they have performed energy measurement studies for a wide range of utility, government, and private clients.

DENT Instruments
United States
Silver Member of BACnet International
www.dentinstruments.com/

EasyIO

EasyIO has been developing 32-bit Ethernet based open HVAC Controllers and solutions for over 12 years, and are recognized as leaders in the field, with robust annual growth and leading edge innovation. With over 70,000 EasyIO Sedona Controllers deployed worldwide, EasyIO has emerged as a world leader in Open Building Automation integration solutions and manufacturer of Ethernet based, DDC Controllers. Their controllers are tested, certified and accredited via CE, UL and FCC.

EasyIO
Malaysia
Gold Member of BACnet International
www.easyio.com/

Fuji Electric

Fuji Electric has created a number of new businesses during the nearly 90 years since their founding. A single theme has linked each of these- that of "Power Electronics Technology" combining power semiconductors, circuits, control systems, and similar technologies. Fuji Electric now aims to become a leading-edge company in "energy and the environment" by building upon our foundation, which consists of the five technology fields that unlock the potential of electricity: power generation/social infrastructure, industrial infrastructure, power electronics, electronic devices and food and beverage distribution.

Fuji Electric
Japan
Silver Member of BACnet International
www.fujielectric.com

ORASS Ltd.

From its inception, ORASS has been working diligently to provide quality service. Knowledge, experience and high performance has kept ORASS growing from day to day with the latest technology in automation products and systems by providing superior service.

ORASS Ltd.
Turkey
Integrator Member of BACnet International
www.orass.com

PcVue Inc.

PcVue Inc., the North America subsidiary of ARC Informatique, delivers advanced, highly flexible and scalable HMI, SCADA software automation solutions that are easy to configure, quick to deploy and deliver a lower total cost of ownership. As a component-based HMI/SCADA supplier for buildings, manufacturing, infrastructures, power generation and distribution, green technologies, food and beverage and pharmaceutical, PcVue sells through distributors, OEMs, and channel partners. Dedicated foremost to provide superior customer service and support to its customers, distributors and system integrators, PcVue prides itself in being highly proactive and service oriented.

PcVue Inc.
United States
Silver Member of BACnet International
usa.pcvuescada.com/

RUNPAQ

RUNPAQ established a "technology service environment" corporate image, promoting "always better" value thinking, "full marketing, total quality" business philosophy to the "project, products, services trinity" of innovation model, a comprehensive implementation of quality, safety and environmental management system standard one, is engaged in the construction and energy saving and environmental protection, scientific research, technological development, market promotion. RUNPAQ is focused on the areas of air conditioning and building energy efficiency, industrial and building automation, thermal power and new energy, electricity and environmental professionals to provide systematic solutions for customers.

RUNPAQ
China
Silver Member
of BACnet International
www.runpaq.com/

WattMaster Controls Inc.

WattMaster Controls Inc., was founded in 1977, primarily to build electronic controllers for Tempmaster Corporation's line of air distribution equipment and systems. The company continued to expand its product line to include energy management systems, and later, complete building automation systems. WattMaster has also been very involved in the design and production of OEM controls for many major HVAC manufacturers and industrial automation companies.

WattMaster Controls Inc.
United States
Gold Member
of BACnet International
www.autozonecontrols.com
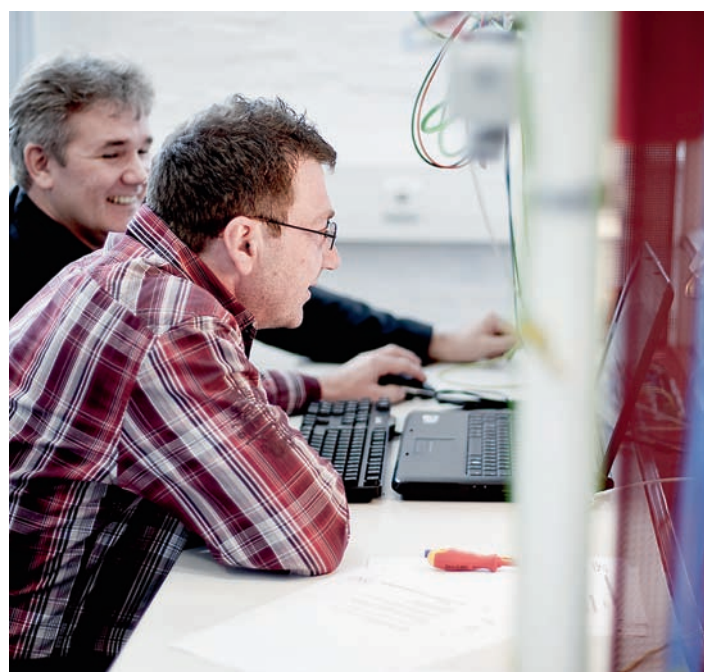
Recent BACnet Events

November was a busy month for BACnet with the BACnet Committee holding its fall interim meeting, the BTL-WG holding its fall face-to-face meeting, and BACnet International's yearly plugfest.

BACnet Committee Interim Meeting

The BACnet Committee held its Fall Interim Meeting on the Georgia Tech campus in Atlanta. The committee has been meeting at Georgia Tech since 2006. For those of us living in colder climes Atlanta makes for a wonderful break from the cold fall weather.

This year the committee spent a lot of time processing public review comments on the numerous in process addenda. The number and quality of the public comments that were received continues to impress. There are many people dedicated to ensuring that the BACnet standard moves forward with quality addenda that are in line with the industry's needs.

MS/TP

There are a few changes to the tried and true BACnet MS/TP datalink that the committee is developing. In the spring, an addendum which increased the allowable size of MS/TP packets saw its first public review. The addendum comments have been processed and a new version should make its way to public review in the spring of 2014.

The development of auto-addressing for MS/TP nodes is nearly ready for public review. Along with other recent proposed changes to MS/TP, MS/TP products should soon be able benefit from reduced engineering efforts allowing for lower installed costs.

Command Prioritization

One of the notable features of BACnet is the command prioritization mechanism. Earlier this year, an addendum went out for public review which added the ability to track where these commands come from. The committee's original approach met with a lot of concern from commenters, so plan B has been drafted and should be ready for a public review in the spring of 2014. These changes are a welcome addition to BACnet as many vendors already provide similar functionality via proprietary extensions. Bringing this functionality into the standard will allow customers to purchase controllers and workstation products from the different vendors, yet still have access to command source information.

BACnet/WS

The Data Modeling Working Group has been meeting bi-weekly to work out the final touches on the BACnet Web Services addendum. At the interim meeting, the committee voted the addendum out for public review. With the acceptance of a draft, a number of companies have agreed to develop prototype implementations and to participate in a plugfest. The goal is to both increase adoption of the new Web Services and to help ensure that the addendum gets a thorough review; one best achieved by attempting to implement to the standard.

Smart Grid

The new web services form the basis of BACnet's Smart Grid platform. At the Atlanta meeting, the Smart Grid Working Group reviewed an overview of how the ASHRAE SPC 201P data model would be rendered in BACnet CSML. A couple members of the working group have worked through a sample use case showing the data that would be required and possible methods for moving it through BACnet Web Services. This was presented to the group and helped to identify the next steps in the analysis. ■

BTL Working Group Meeting

Two weeks after the BACnet Committee meeting in Atlanta, the BTL Working Group gathered BACnet experts in Atlanta for a face-to-face meeting before the BACnet International Interoperability Plugfest. It seems that Atlanta is the center of the BACnet universe these days.

The BTL-WG is actively working on the next release of the BTL Test Package. The next release is aimed at protocol revision 14, bringing in testing for the new alarming functionality and the lighting related objects and services.

The tests are being developed in collaboration with the BACnet Committee. In the past, tests were developed by the BTL-WG and after the BTL-WG finalized them they would be passed to the BACnet Committee for review and ratification into the testing standard. With both groups focused on the tests at the same time, for the first time in the BTL-WG history, the tests are being developed and reviewed in parallel by the two committees. ■

BACnet International Plugfest

Following the BTL-WG meeting, the annual BACnet International Plugfest was held. There were 46 registered teams from 38 companies. The plugfest was held over 2 ½ days and consisted of 12 test sessions and 2 presentations. In addition, an open free form test table was present where participants could go to test outside of the test sessions.

The test sessions consist of 2 or 3 vendors connecting their equipment together to check their BACnet implementations against each other. During the test session competitors will share BACnet knowledge; tricks and traps; do's and don'ts. None of which I can relate as the whole event is covered by an NDA which allows a more open and free discussion of product implementations and design choices (at least as they relate to interoperability.)

Coleman Brumley, from PolarSoft, presented details of BACnet over IPv6 as described in Addendum 135-2012ai which will be going out for public review in the spring of 2014. Dan Kollodge, from Trane, presented the BTL-WG's motivations for the recent policy change regarding the minimum listable protocol revision. The initial effects of the policy will start In January, 2014, with the minimum protocol revision for listing being set at 7. For more information on this policy, see the BTL Test Documentation page on the BACnet International website.

For those that have never been to a plugfest, the event can be eye-opening. The close cooperative environment is one that most will not see in the real world. We are exposed to competitors' products and the thinking behind them. Frequently interoperable issues occur, not because of limitations in the standard, but rather a lack of understanding of how wide ranging product designs can be. Too frequently developers are only exposed to their own company's products and product deployment practices. This lack of exposure means that they do not consider how competitors approach similar issues and thus do not take these alternative viewpoints into account when designing the next killer-widget.

Developers are generally kept locked in back rooms frantically developing building automation products. When they are let out and encounter competitors in the real world, it is frequently in confrontational situations where, for one reason or another, a multi-vendor installation is misbehaving. At the plugfest, there is little in the way of confrontation; in fact there is usually a lot of cooperation. The goal is to make all of the products more interoperable so that in the future fewer of those negative real-world experiences occur.

At the end of the session there were a lot of tired developers dragging their equipment back to home base for repairs. All in all, it was a successful event!
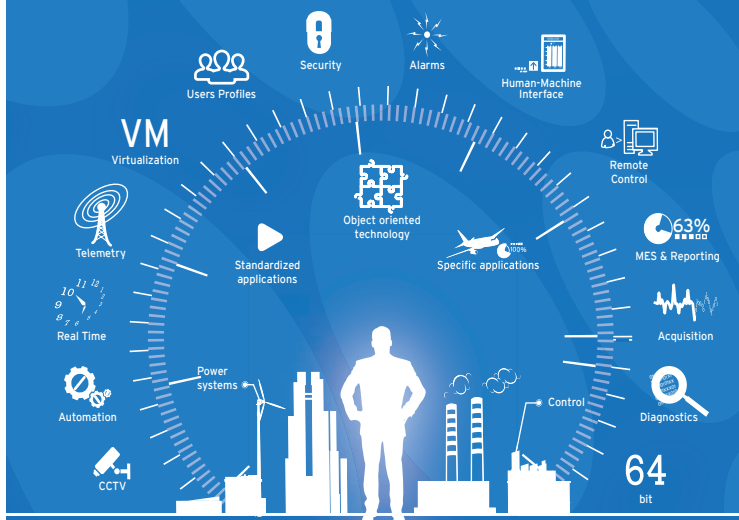
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Editorial Notes

Calendar of BACnet Events

Date	Location	Event	Highlights
2014			
January 21-23, 2014	New York, NY	AHR Expo	BACnet International booth #114 (member product showcase display) and education track
March 4-6, 2014	Baltimore, MD	NFMT	BACnet International booth
June 1-5, 2014	Las Vegas, NV	LightFair International	BACnet International booth
October 7-8, 2014	Las Vegas, NV	NFMTVegas	BACnet International booth, education sessions, awards ceremony and reception
October 22-24, 2014	New Orleans, LA	Greenbuild	BACnet International booth

Information about all Events:

Natalie Nardone, CAE, CMP, BACnet International Office,
natalie@bacnetinternational.org

BACnet Toolbox

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Online: BACeye.com

Single User License :
$ 279.-

❶ Property view
❷ Calendrier view
❸ Alarme view

Supported **BACnet** functions	Other Tools	BACeye
Scan and Browse the network	√	√
Read/Write Properties	√	√
EDE-Export	?	√
Object Support BACnet Revision 12	?	√
Manual and Batch Backup/Restore	X	√
Configurable Quick Watch Window	X	√
Fullscreen Property View	X	√
Configurable COV / Polling	?	√
Customer specific project configuration	X	√
Fulltext Search Functions	X	√
Filter functions	X	√
Colored View for status-flags	X	√
Graphical display Calendar/Schedule objects	?	√
BACnet/IP including BBMD and FD support	?	√
no Windows service installation required, soft-license no dongle required	X	√

MBS GmbH | **your partner for industrial and building automation**
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info@mbs-software.de | www.mbs-software.de

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