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November 2023

Control of CO_2, temperature and volumetric flow.

Belimo ZoneEase™ VAV

Belimo ZoneEase™ VAV is a VAV-based zone control solution with pre-loaded and configurable applications. The main components of the turnkey solution are the VAV controller and the room operating unit. Room operating units are available with or without display. The latter is operated via the end user's smartphone. The solution comes with commissioning and maintenance support via the cloud, which reduces project complexity and downtime while increasing connectivity, data transparency and cost efficiency.

- Pre-loaded and configurable zone control applications
- Cloud-based engineering and commissioning workflow
- Smartphone access via NFC to VAV controller or room operating unit
- Seamless integration with BACnet MS/TP

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BELIMO

Securing a Smart Future Through BACnet/SC and Building Management

The Middle East's architectural skyline is evolving at an unprecedented pace, with smart buildings at the forefront of this change. In this editorial, we take a closer look at the crucial role of the BACnet protocol and highlight its impact on security (BACnet/SC) and building management in the region.

BACnet/SC: A strong foundation

In an era dominated by digital connectivity, cyber security plays a major role. BACnet/SC, the Secure Connect extension of the BACnet protocol, is serves as guardian of smart buildings against cyber threats. The Middle East, with its growing smart infrastructure, needs a robust solution that not only facilitates communication but also protects against unauthorized access and data breaches.

BACnet/SC achieves this through standardized security measures that ensure critical systems remaining resilient in the face of rising cyber threats. Authentication and encryption provide the foundation to create a secure communication framework for devices. In a region where industries such as finance and healthcare demand the highest levels of data integrity, BACnet/SC is a showcase that provides a standardized solution for enhanced cybersecurity.

Building management redefined: The integration magic of BACnet

Facility managers in the Middle East face the challenge of optimizing operational efficiency while ensuring the well-being of occupants. BACnet, with its open and vendor-neutral protocol, is the linchpin in this endeavor. The seamless integration of different building systems through the protocol provides building managers with unparalleled control and transparency.

Real-time monitoring, analysis and diagnostics merge via BACnet, providing a holistic view of the building portfolio. The Middle East's ambitious smart city projects can utilize BACnet's capabilities to create sustainable, intelligent urban spaces. The protocol's adaptability allows building managers to select the most appropriate solutions for their specific needs, ensuring flexibility in an ever-evolving landscape of smart buildings.

A collaborative future: BACnet paves the way

As we envision the future of smart buildings in the Middle East, the symbiosis between BACnet, security and building management becomes a game changer. BACnet is not just a protocol but a catalyst that is driving the Middle East towards smart, resilient buildings. By getting involved with BACnet and its dual focus on security and building management, the region can put itself at the forefront of the global smart building revolution. In the Middle East, the future is not only smart, but also safe, efficient and BACnet-enabled.

Hans Symanczik
Founding member of BIG-EU

BTL CERTIFICATION

Simplifying System Integration

BACnet is the world's standard for building automation solutions because it simplifies integration and enables intellingent buildings. But, it only works when BACnet products are correctly implemented. **BTL certification is critical to ensuring correct implementation.**

BTL Certification provides customers, end-users and building owners/operators with assurance that a product has successfully undergone industry-standard testing conducted by recognized, independent testing organizations.

It also provides users with confidence on product quality and interoperability in a multi-vendor environment, and can help **minimize costs and risks associated with system integration**.

For suppliers, BTL testing is a powerful methodology for **finding and eliminating implementation errors** before a product reaches the market.

Products that have successfully passed conformance testing are eligible for a BTL Certification and added to the BTL Listing. Only BTL Listed products may use the BTL Mark.

The BTL Mark is a mark of distinction and has come to represent a high level of quality and conformance. It is becoming commonplace for specifications to require a BTL Mark in order to be eligible to bid on a project.

To find out more about testing, or to view the list of tested products, visit **btl.org**.

There are over 1300 products in the BTL Listing of Tested Products Database.

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UAE Financial District
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This issue can be downloaded from www.BACnetjournal.org

BMS Serves Up a Treat at Indian Restaurant in Leicester

Entrance area of the Tandem Restaurant in Leicester.

The exclusive Tandem restaurant serves up authentic Indian flavours with Goan influences for casual, fine and executive dining experiences in five separate rooms across two floors at Leicester's High cross shopping centre. When the restaurant's BMS system faltered, they called in Nottingham-based BMS Technical Ltd, who installed a Distech Controls BMS system throughout. The upgrade ensured the comfort of customers, allowing the restaurant to concentrate on meeting Government and Public Health Guidelines for safe re-opening, as well as bringing the opportunity for remote monitoring and management of HVAC services via the Distech Controls smartphone application.

"We were called in at short notice, and found it was a relatively old system, with a number of controllers scattered around," says Les Harrop, Managing Director at BMS Technical Ltd. "The main controller operating the boilers and pumps had failed totally. Tandem's owners were very keen to get it fixed as soon as possible to allow them to focus on safely reopening for a May deadline after lockdown."

The client agreed to replace the entire system, and the BMS Technical Ltd team began to work on writing the software immediately. BMS Technical specified a Distech Controls BACnet/IP ECLYPSE Connected System Controller. The part contemporary and part Grade II Listed building provided several installation challenges for the team to overcome.

Control cabinet with built-in ECLYPSE Connected System Controllers.

Insight into the interior of the Tandem Restaurant in Leicester.

"We had an issue with the air handling unit on the roof. When Tandem moved in, because they were unable to fix anything on the walls (due to the listed building restrictions), they plaster boarded everything on the inside," adds Les. "As a result, lots of cable routes were hidden away, and there was no way of getting an ethernet cable from the basement to the roof. We decided to use an MS/TP system and a Distech Controls ECB-203 Series controller. Its display was very helpful when it came to checking that the signals from the panel in the basement were getting up to the controller on the roof. We chose Distech Controls because we felt they could do everything required for the project."

A further issue was a faulty space sensor on the restaurant's ground floor, which may have been damaged during building work and failed to give a reading. BMS Technical Ltd opted to install a wireless Distech Controls Allure ECW-Sensor, a discrete wireless battery-less room temperature sensor. "We put the receiver down in the basement, and then enabled the space sensor. The client was very impressed, and they are now able to monitor temperatures on both the ground floor and first floor."

Because the panel was in the basement, BMS Technical suggested Distech Controls' myDC Control app to allow Tandem to monitor the system without having to go back down into the basement. The controller was added to the IT network, the app was set up with the use of 'favourites' to enable the owners to see and adjust temperature, check whether the AHU was running correctly and alter time schedules.

"I'm very pleased we chose Distech Controls because everything was right for that project – the app, wireless sensor and AHU controller all worked perfectly and were exactly what we needed," adds Les. ■

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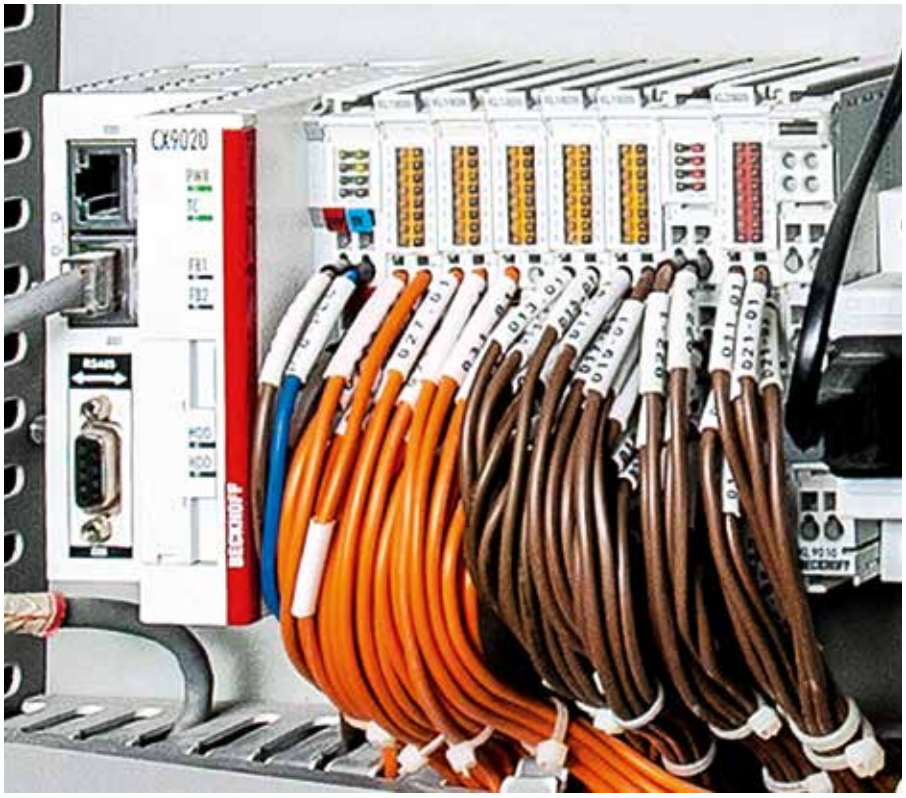
Fully Automated Building Operation Enables Significant Energy Savings

The H-shaped building has, through a digital building twin, abilities for self-diagnostics, self-analysis and autonomous decision-making.
© Dongfeng Design Institute

Building H in Wuhan was designed with green buildings in mind from the outset. The open control technology from Beckhoff made it easy to integrate all equipment into the building management system developed by Dongfeng Design Institute.
A digital building twin provides capabilities for self-diagnostics, self-analysis and even autonomous decision-making.

The building management system incorporates all relevant sub-systems. © Dongfeng Design Institute



CX9020 Embedded PC with directly attached Bus Terminals in a building control cabinet. © Dongfeng Design Institute

Building H is a landmark building in the Wuhan Economic and Technological Development Zone (WEDZ) with a floor area of 82,000 m². With its H-shaped design, it maximizes the use of natural light for illumination. A photovoltaic power station built on the roof provides an annual energy generation capacity of over 200,000 kWh, which basically corresponds to the annual electricity consumption of the building's lighting. A rainwater collection device with a volume of 300 m3 on the roof provides recycled water for cleaning the building and watering the plants. The project was implemented by high-tech enterprise Dongfeng Design Institute.

The smart building management system incorporates, for example, building automation, energy management, facility management, fire protection, access security and environmental monitoring. All these are combined through the "DFD intelligent building operation and maintenance management platform" developed by Dongfeng Design Institute. It realizes a digital twin system through mutual mapping and bidirectional control between the real physical environment and the virtual digital space.

A model in the field of building automation

There is no single wall switch for controlling the lighting for the public zones in the building. All the lights are controlled automatically through a control system from Beckhoff, which on the hardware side consists of CX9020 Embedded PCs – also certified as BACnet Building Controllers – BK9050 Bus Couplers for Ethernet TCP/IP communication and diverse Bus Terminals. The star topology is easy to network and convenient for management and maintenance purposes. The control system also supports the latest DALI 2 lighting technology and KNX for infrared human presence sensors, which significantly simplifies wiring. TwinCAT automation software from Beckhoff facilitates the engineering process.

Different types of presence sensors, combined with the continuous evolution of intelligent control algorithms, has resulted, in lighting energy savings of more than 40 % over two years of operation. Tangible benefits could also be achieved in air conditioning. "The building uses a VRV (Variable Refrigerant Volume) air conditioning system, which is connected to the Beckhoff control platform via the BACnet fieldbus for simple wiring and easy maintenance. Combined with the algorithm for human presence detection, the HVAC energy savings rate exceeds 20 %," says Ke Zhenyu, project implementation manager for Building H. ■

BECKHOFF

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ABB drives for HVACR
Effortless connectivity for building automation

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—

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Creating a Scalable Solution for Financial Districts

UAE Financial District © GettyImages

Flexible, integrable, and scalable solutions improving tenants' experience and maintaining high-quality standards with cost-effective solutions.

One of the key features that distinguishes a top-tier financial district, in addition to its services, is the adaptability and scalability of its building management infrastructure. How effectively is the indoor environment managed? How advanced are the facility's smart features? Does it offer a tenant-friendly experience?

Creating a multi-level connected system with BACnet

Johnson Controls implemented their Building Management System – Metasys that answers the facility's challenges and is built, developed, or reconfigured in phases together with its OpenBlue Enterprise Manager that offers flexibility, scalability, and advanced analysis capabilities to generate a smart facility using the BACnet protocol for multi-level, multi-system integration that was further communicating data with the Building Management System (BMS).

The Metasys BMS builds on more than 30 years of innovation to deliver industry-leading features and capabilities with bottom-line benefits that optimize building systems to boost team productivity and increase effectiveness.–

Metasys uses BACnet-based field and supervisory controllers to monitor and control HVAC systems such as AHU's & FCU's across multiple buildings. These controllers follow the guidelines defined under the recent BACnet Protocol Revision to allow for greater control and ease of use. The system also integrates multiple critical sub-systems such as Fire Alarm, Energy Management, and Metering System using off-the-shelf, robust & open supervisory network controllers that have a BACnet Building Controller (B-BC) profile.

For this project, Metasys acts as an Enterprise Building Management System that seamlessly integrates third-party BMS systems via BACnet/IP.

Financial Districts around the world navigate the challenges of our rapidly changing world. Technology and digitalization are empowering building owners with data and analytics combined with real-time remote monitoring, control, and management of the systems in the building. Through Johnson controls Metasys Building Management System, the Financial District is now equipped with easy and remote access, quick alerts, flexible environments, and improved communication. ■

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Fan Array Integration

Fan arrays are becoming more prevalent in HVACR applications in many parts of the world, replacing traditional set-ups. Fan arrays have multiple small fans instead of one larger fan. The result? Improved redundancy, easier maintenance, and enhanced performance. But what about their integration over BACnet? Let's explore how fan arrays work and integrate into building management systems (BMS).

Before diving into integration, we first must understand the different fan array designs – as each design impacts how to integrate and what data is available. Fan arrays may be powered by one large variable speed drive (VSD), one VSD per motor/fan, or by electronically commutated motors (ECMs). For example, a 2x2 array designed with 5,5 kW motors/fans, may be controlled by a single 22 kW VSD, (4) 5,5 kW VSDs, or (4) 5,5 kW ECMs.

The controls contractor's integration to the fan array will differ based on which of the (3) above designs are used. Let's look at some integration scenarios for each of those designs.

One large VSD, multiple small motors

VSDs designed for HVACR applications usually have BACnet MS/TP included as standard and they may offer BACnet/IP as an option. This one-large-VSD (Figure 1: Single VSD fan array) is the easiest to integrate of the (3) fan array designs. Controls contractors have been integrating VSDs into the system for years, whether fan, pump, or cooling tower applications. The initial BACnet integration to a VSD in a fan array isn't very different from other applications, although some care must be taken such that the data is accurately presented on the operator workstation (OWS) graphics. A couple items to remember:

- Update the graphical image to show an array instead of a single fan – easy to miss this simple task when doing graphics work offsite and one is thinking about the single VSD
- Verify the text is accurate for all variables displayed on the graphics – we are dealing with "total" power and "total" amps instead of individual motor power/amps

A package, with one-large-VSD powering multiple small motors, will include some form of individual overload protection per motor, such as manual motor protectors (MMP). The most common integration "miss" with these array designs is to forget to monitor the MMP status. A single motor that becomes gradually overloaded in the array (i.e. bad bearing) is disconnected from the VSD by the MMP. These MMPs can come with an auxiliary contact for status which can be monitored by the local controller. Ideally, any open MMP would throw an alarm in the BMS and alert the facility personnel. Pro tip: Wiring the aux contacts in series back to a VSD's unused digital input and then monitoring that DI over BACnet – saves on wiring costs and a DI on the local controller. Consulting Engineers should take note to clearly document the need for aux contacts on the MMP and for the controls contractor to monitor their status.

There is a sub-set of the one-large-VSD solution, and that is a redundant VSD package. This package (Figure 2: Redundant VSD fan array) has a primary VSD and a secondary/back-up VSD, thus removing the VSD component from being a single point-of-failure. If the primary VSD fails, the secondary VSD would then power the array. Redundant VSDs are popular for VAV (variable air volume) and for fan array designs that are designed to run above nominal utility frequency (i.e. 50 or 60 Hz). The BACnet integration to a redundant package should result in both drives shown and their status/data properly identified on the OWS graphics. Depending on the application and owner's preference, the redundant drive package could be configured to either manually transfer to the back-up VSD, automatically transfer, or allow the BMS to control which drive is powering the array. While ideally these items would be clear in the sequence of operation and appropriate control wire pulled upfront, one beauty of BACnet is that it allows flexibility to have these types of controls changed quickly on the fly with minimal wiring changes.

One VSD per motor

From an integration viewpoint, the one-VSD-per-motor solution (Figure 3: One VSD per motor fan array) has some similarities to the above, but there are a few key differences:

- Data pulled from the VSDs is for each fan/motor – thus both individual values/status for each VSD, along with the total values (i.e. power), should be available on the graphics
- There are no MMPs to monitor – traditional BACnet integration makes it easy to see the status of each VSD and verify proof-of-flow

Are you also responsible for implementing equipment safeties, such as a high static safety or smoke alarm? If so, make sure the safeties are wired back to all the VSDs. Due to the temptation of simplicity, one pitfall is to run the safeties into

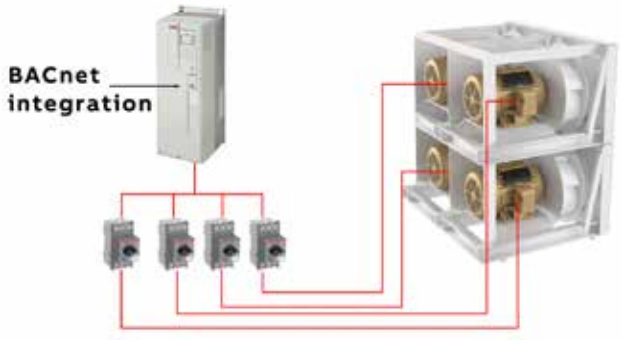

Figure 1: Single VSD fan array

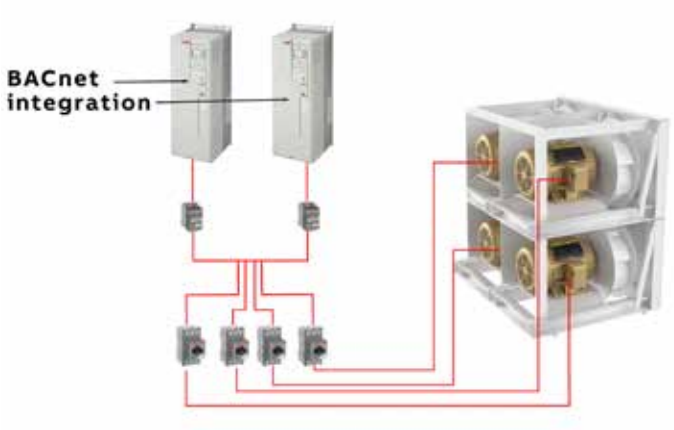

Figure 2: Redundant VSD fan array

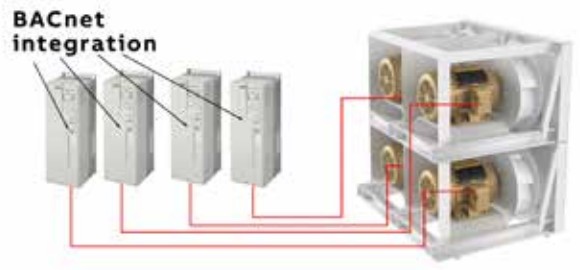

Figure 3: One VSD per motor fan array

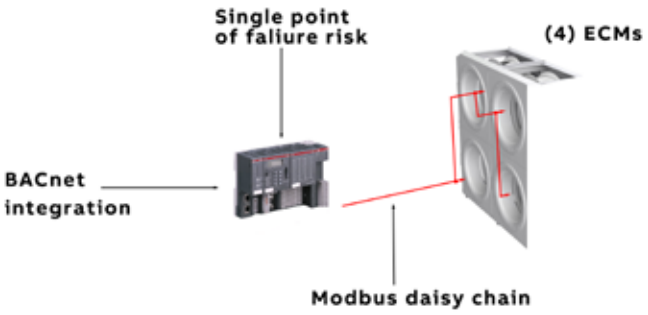

Figure 4: ECM fan array

to the shared start/stop relay logic, which results in an open safety removing the start command from all the VSDs. While this does stop the VSDs (when the drive is in Auto mode), unfortunately the safeties are no longer in the circuit for Hand mode. Safeties must be functional in Auto and Hand mode.

ECMs

Over the past 10 years, ECMs have become another popular solution for fan arrays. The initial popularity was due to high efficiency, thus energy savings, of an ECM compared to a traditional AC induction motor. This healthy competition of motor technologies resulted in additional motors developed for fan arrays – ones like the VSD powered ferrite assisted synchronous reluctance motor, that are more efficient than an ECM. While ECMs are no longer the most efficient solution for fan arrays, some air handlers have standardized on them, and controls contractors should be prepared on how best to integrate them.

One may expect that ECMs have similar integration characteristics as the one-VSD-per-motor, but that's not typically the case. The control and integration with ECM based arrays are not as standardized. Only some ECMs include BACnet, with most (Figure 4: ECM fan array) using Modbus to an intermediary controller or gateway. That controller then talks BACnet to the BMS. Even if the ECM has BACnet, there may still be an intermediary controller involved for general control or to offer Hand functionality that is expected on air handlers. ECMs themselves do not offer a Hand function and the intermediary controller/HMI can offer a Hand function via touchscreen. However, that controller/HMI does become a single point-of-failure risk, which can take an entire array offline, thus defeating the whole reason the Hand function was included. Hand mode is intended for when the controls fail.

The first step in integrating to ECMs is to determine if the integration is directly to the ECMs (and if so, what protocol) or if the integration point is the intermediary controller. Assuming the integration point is to the intermediary controller, now the controls contractor should determine which data points are offered from that controller and which to show on the OWS. Too often that intermediary device has a very limited object list. For example, an ECM may have 20 points of data available, but if the intermediary controller is only requesting (3) status/data points over Modbus from the ECM, then the BMS will only be able to read those (3) data points from the intermediary device. Consulting Engineers should communicate clear expectations for the fan array's intermediary controller and the controls contractor's responsible point list, otherwise the owner may have a very limited OWS graphics/data when it comes to an ECM fan array solution. Unlike when integrating directly to the device (VSD or ECM), it is much harder to adjust the points list after-the-fact with intermediary controllers.

Are you responsible for designing or implementing smoke control/evacuation controls? If so, care must be taken and possible early coordination with the authority having jurisdiction (AHJ) on what will be deemed acceptable functionality in Auto and Hand modes of operation. ECMs typically do not have specialized smoke control override logic so a limited variation of smoke control is handled via the intermediary controller. Critical fan array applications want to minimize single point-of-failure risks, which may result in a Hand mode design that is hardwired (switches and potentiometers). However, if that hardwired variation of Hand mode is implemented to provide the most reliable solution, then there is no specialized fire control logic available in Hand mode. These are considerations that hopefully occurred up front in the design and are not something being figured out during commissioning.

Summary

There is an incredible amount of useful data in HVACR devices. That data is just waiting to be extracted via BACnet and displayed and trended on the owner's OWS. For over 15 years controls contractors have been pulling that data via BACnet from single VSD applications. With fan arrays and their multiple motors, we have the added wrinkle of the possibility of multiple VSDs or multiple ECMs being involved. Someone familiar with a single VSD integration will typically quickly figure out the nuances of integrating to a multiple VSD fan array. Proper integration to an ECM based fan array is also possible but the available data may be limited if expectations were not communicated early on in the project. ■

ABOUT THE AUTHOR

Tim Skell, Global HVACR Application Engineering Manager at ABB, has been working with variable frequency drives (VFDs) in the HVAC industry for over 20 years. He is also active in the BACnet community and has received a past BACnet Member of the Year award.

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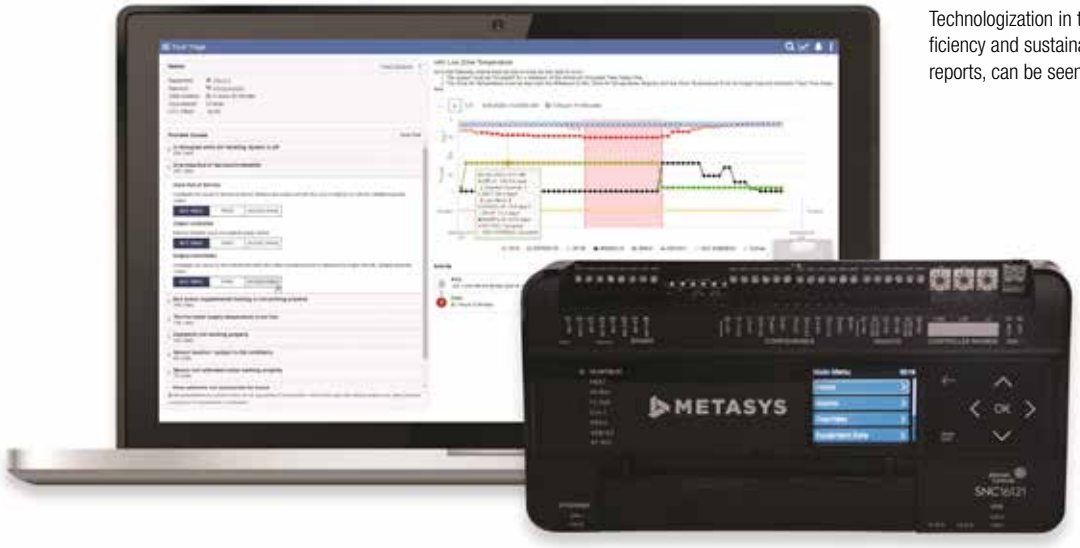
Recognizing Potential: How Building Automation Pays Off for the Climate Turnaround



Technologization in the direction of greater energy efficiency and sustainability, also in order to publish ESG reports, can be seen in all areas.

Climate change is one of the biggest challenges of the 21st century. Because it is responsible for almost 40 percent of global greenhouse gas emissions, the building sector has significant potential to drive climate change. Building automation plays an essential role in this – and politics and its legislation at European and national level currently provide additional incentives for implementation, especially in facility management.

Technologization towards more energy efficiency and sustainability is already evident in the building sector in many areas. However, the degree of technologization is highly dependent on the sector or market segment. For example, there is still a lot of untapped potential in the education sector for achieving decarbonization goals because the public sector often lacks personnel and investment funds. Thus, the modernization and retrofitting of existing buildings in Germany remains a weighty challenge. But it is becoming clear that without building automation, it is often no longer possible to meet the requirements of standards or to achieve building certification – for example, according to DGNB, LEED or BREEAM. Building automation will also be indispensable for the preparation of ESG reports, which will be mandatory for many companies from this year onwards.

Building automation facilitates facility management

The classic building services such as heating, ventilation, air conditioning and room automation are usually integrated into the building automation. Increasingly, however, other trades are also being integrated – ranging from lighting, shading or weather data including weather forecasts to the integration of low-voltage distributions to video technology and access control. Open, standardized interfaces such as BACnet open up numerous other possibilities.

This development is important and will continue to expand. This is because more advanced automation provides building operators with much more data and thus valuable information, thanks to which they can draw conclusions and react better and faster. For example, they can monitor the energy efficiency of their buildings more comprehensively and recognize malfunctions in the area of technical facility management predictively.

Large facility service providers are already taking over parts of the maintenance via building automation systems. Their responsibilities will continue to expand as networking becomes more and more complex – but this is indispensable in order to fully exploit the currently still untapped potential for increasing building efficiency and profitability.

And here it should be emphasized: We all move in a very fast-changing environment and newer requirements – for example with regard to cyber security – can only be solved through continuous support and together. This is why the service business is of central importance for building automation system providers like us. We are at our customers' side throughout the entire technical operation and accompany them professionally over the entire life cycle of a building.

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New Sedona Unitary Controller Adds Support for BACnet MS/TP

Contemporary Controls has expanded its BAScontrol Series of BACnet/IP Sedona Unitary Controllers with the addition of the 22-point BAScontrol22S, which supports BACnet client/server operation over BACnet/IP or BACnet MS/TP.

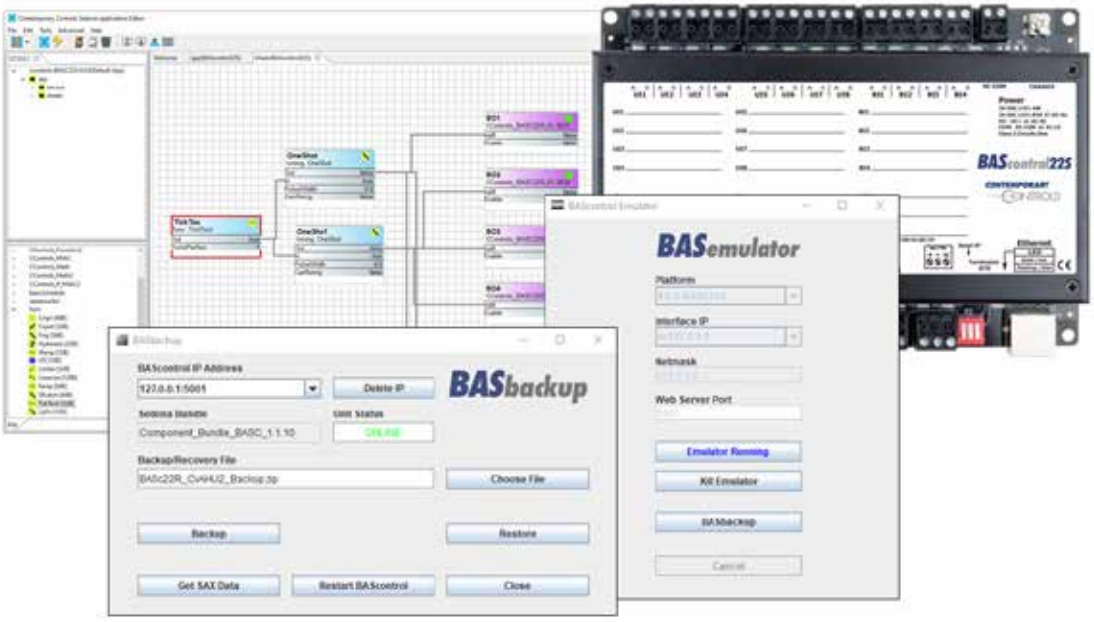
"While the trend is towards using IP-based networks, the BAScontrol22S offers flexibility at the job site in case there is no access to an IP-based network, and a twisted-pair network is the only option," said Harpartap Parmar, director of product management at Contemporary Controls. "Sedona function block programming and project archiving is still accomplished over the Ethernet port connected to a PC using the free BAScontrol Toolset while the controller communicates over BACnet MS/TP."

The BAScontrol22S retains the features found in all BAScontrol Series controllers, such as license-free operation and web page configuration over a 10/100 Mbps Ethernet. It complies with the B-ASC device profile with a convenient mix of 8 universal inputs, 4 binary inputs, 4 analog outputs, and 6 binary outputs. The unit has 48 web components which link Sedona wiresheet readable/writeable data to web pages, and 24 virtual points which link Sedona wiresheet readable/writeable data to a BACnet client. Its rugged metal enclosure, low device profile, and outdoor temperature operation of -40°C to +75°C make it ideal for indoor or outdoor applications. The unit is powered by 24VAC, commonly used in HVAC systems, or 24VDC.

The BAScontrol22S was built on firmware release 4.0.x with operational enhancements made to improve performance, develop more sophisticated Sedona components, increase application memory space, and to upgrade to BACnet release 15. In addition to the BACnet/IP Ethernet port, the BAScontrol22S has one non-isolated (2-wire) BACnet MS/TP serial port to provide BACnet client/server operation over BACnet/IP as well as BACnet MS/TP up to 115.2 kbps. Transmit and receive LEDs flash on MS/TP traffic.

BAScontrol22S 22-point unitary controller supports BACnet client/server operation over BACnet/IP or BACnet MS/TP. © Contemporary Controls

Contemporary Controls' BAScontrol Toolset is a free set of software tools for Windows PC that includes the Sedona Application Editor (SAE) which allows for Sedona programming, BASbackup which can save/restore and replicate the application and full configuration as a single project file, and BASemulator which will emulate full controller operation on a PC. The BAScontrol Toolset and a web browser are all that is needed to commission a BAScontrol controller. ■



The BAScontrol Toolset is a free set of software tools for Windows PC that includes the SAE, BASbackup project archiving tool, and a BASemulator which will emulate full controller operation on a PC. © Contemporary Controls

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Easy to Use VAV-Based Zone Control Solution with Pre-Loaded Applications to Control CO_2, Temperature and Volumetric Flow

Belimo ZoneEase VAV is a VAV-based zone control solution with 19 pre-loaded and configurable applications. The solution encompasses a cloud-based engineering and commissioning workflow with offline capabilities to support a seamless and error-free experience. The link from the zone control solution to its project data in the cloud is done via commissioner's smartphone with integrated NFC communication. Wireless smartphone access to ZoneEase VAV system is possible via the VAV actuator or its connected room operating unit. That allows time saving and avoids the need to open the ceiling.

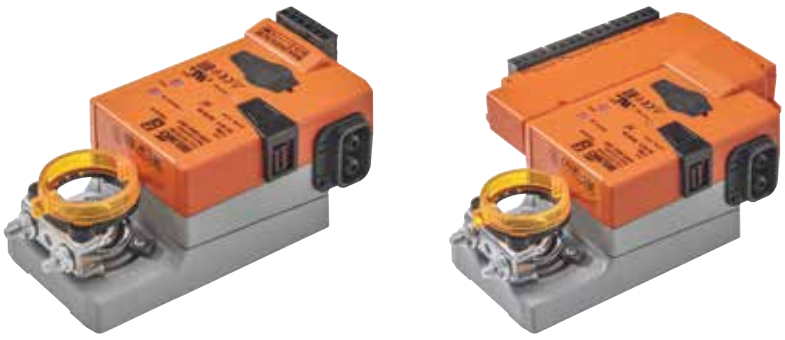
The cloud supported workflow provides easy and configurable access to share and change zone control data to different project stakeholders as for instance the VAV OEMs, planning officers, system integrators, back-office workers, local site commissioners and in the end also to the facility managers. The unavoidable project and parameter changes in the phase of planning and commissioning are thus cleverly solved.

ZoneEase VAV controllers come with or without attached I/O module, providing stand-alone capability as well as scalable open space area installations. Seamless BACS integration is achieved over BACnet MS/TP or Modbus RTU. All configuration parameters and setpoints can be accessed via bus communication, which provides the opportunity to change the zone control from BACS. Of course, local access via smartphone is possible as well. Such local actions are synchronized with the project data in the cloud.

Basic applications can be extended with an optional VAV unit. The secondary VAV damper operates as supply air or extract air unit. Room temperature control applications can be combined with IAQ (indoor air quality, CO_2) control. Supplementary components can be added to enhance precise measurement or to increase functional use.

The dedicated room operating units are provided in divers variety. Variants with configurable e-Paper touch display are provided as well as variants without physical display. The room operating units without physical display are operated with end user's smartphones.

www.belimo.com/ch/en_GB/products/systems/product-documentation/zoneease



VAV zone control actuators 5 / 10 Nm
LMV/NMV-BAC-001 and LMV/NMV-BAC-002

Room Operating Units and Belimo Display App
P22RT..-1T00D1 and P22RT..-1T-1

BELIMO Automation AG
info@belimo.ch | www.belimo.ch

New BACnet Module with Extra Power

Current carrying capacity of 150 mA enables switching of several loads.

Acquisition of signals from different sources.

Metz Connect introduces the new BMT-AOP2 BACnet MS/TP – an analog output module with galvanic isolation for controlling and switching many more loads than previous modules in an energy-efficient manner for decentralized switching tasks thanks to the increased current carrying capacity per channel.

In greenhouses, parking garages, and other public buildings such as railway stations, lighting can be controlled from just one single device using the BACnet protocol.

Simple and intelligent automation

In building automation, analog signals with a DC voltage of 0 V to 10 V are usually used. For many applications, a current carrying capacity of 10 mA at the outputs and inputs is sufficient. The BMT-AOP2 analog output module, on the other hand, has two analog outputs with a current carrying capacity of 150 mA per channel. This allows up to 15 loads to be controlled simultaneously with a current consumption of 10 mA per channel. This means BACnet users can now automate specific areas of a building in a simpler, more efficient, and smarter way.

The module can be used to control various sources (lights or active sensors with DC voltages from 0 V to 10 V) and can also switch valves, pumps, burners, lights, and actuators. Its advantages include decentralized and autonomous use through manual operation, i.e., a small lever on each module for manual intervention. The output channels are galvanically isolated from each other and from the supply voltage through basic insulation in the device. ■

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How Healthy is Your Building?

Building operators are well advised to run a "diagnosis" of the efficiency of their properties. This move makes good economic sense as energy costs steadily rise, and will also uncover untapped opportunities for improvement and potential savings in building operations. Engineering agency Thürmer and TÜV SÜD are working together on supporting a German financial services provider which is seeking to implement a completely new building automation system in an existing building.

Building operators are facing the challenge of increasingly strict statutory and regulatory requirements for building efficiency. However, these legal conditions can be overcome with the help of construction engineering as well as building services systems (BSS). To give a few examples: Design errors in building services systems cannot always be ruled out. Systems and equipment configuration may be incorrect or inadequate. BSS performance may be affected by incorrect installation or calibration of various sensors, obsolete building services systems and lack of insulation in existing buildings. As possible consequences, parts of an existing building may be heated and cooled simultaneously. Some equipment may also run in permanent on/off mode instead of continuous part-load. And last but not least, the efficiency and technical standards of new systems and equipment are improving all the time.

Analysing "blood test" results

There are many reasons for performing regular "health checks" on buildings. The obvious question in this context is: why not use the data available from the various trades involved in building services systems (BSS) as a basis for diagnosing the health of the building, in the same way as doctors use blood test results to gain a picture of a patient's health? While the law does not require building operators to test BSS functions before taking a building into operation, there are directives, guidelines and recommendations in place that may be used as basis for such a health check. They include VDI 6041 "Facility Management – Technical monitoring of buildings and building services", AMEV Recommendation 158 – "Technical Monitoring 2020" and the VDI 3814 – Building automation series of standards.

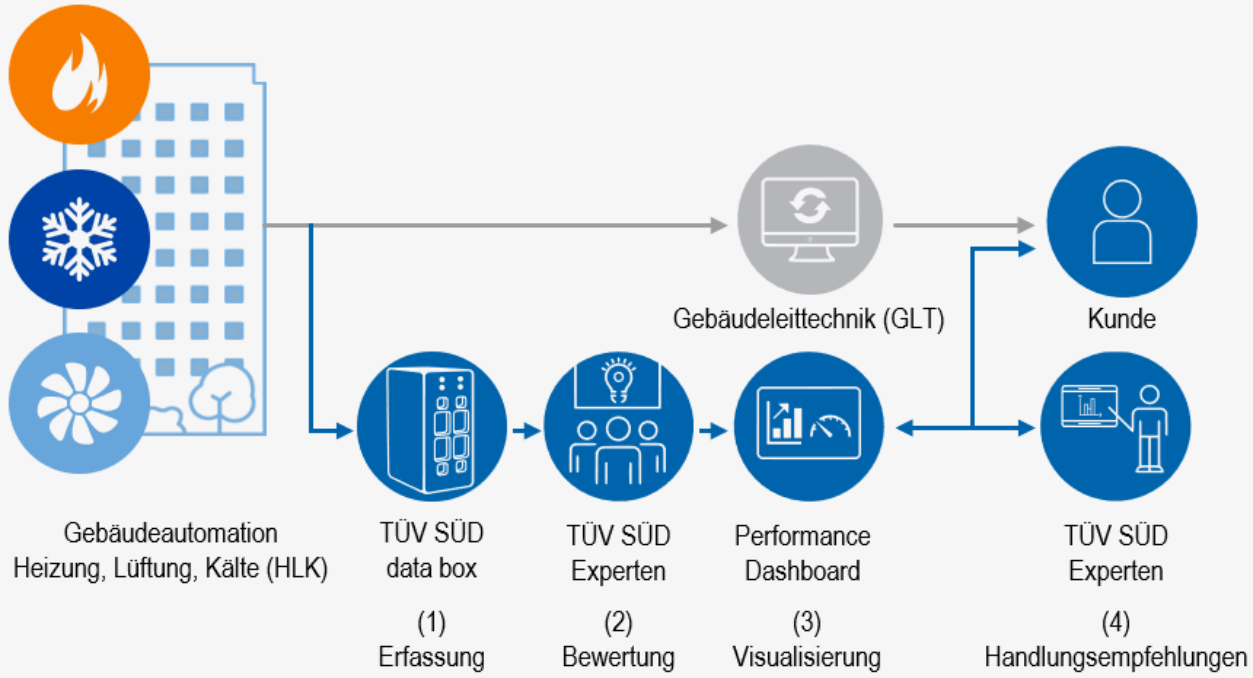
In other words, even at this early stage it is already possible to start a process which ensures that the building automation (BA) – the "brain" of a building – engages in continual learning and further development. This would be highly beneficial given that building operations vary widely due to the differences in building use profiles. Successful optimisation will not come overnight, but will take some time. Given this, it is important to start continuous data analysis and evaluation as early as possible.

Speaking the same language

So what regulating factors do TÜV SÜD experts use to ensure BA works in line with this principle and optimise the interaction between all BSS step by step? The challenge is to bring the various communication methods and file formats of these systems together in a common language. To do so, the first step involves uniform identification of the BSS elements, using the identifiers set forth in standards such as DIN 6779-12 or VDI 3814 Part 4.1. One protocol that enables communication between building services systems is BACnet. TÜV SÜD Industrie Service GmbH holds accreditation as an international BACnet testing laboratory. The testing, inspection, and certification (TIC) company is thus authorised to assess products for their conformity with the BACnet standard. Once a common language has been found, data analysis and evaluation conducted within the scope of technical monitoring can start to detect potential nonconformities and opportunities for improvement.

Case study: Full health checkup

This term could describe the project in which TÜV SÜD and engineering agency THÜRMER Ingenieure GmbH are supporting a financial services provider headquartered in southern Germany, which operates existing buildings at



Procedure for optimising an existing building automation system. © TÜV SÜD

Secured data transfer via the Data Box.
© THÜRMER Ingenieure

various locations throughout the country. In the course of comprehensive modernisation measures, a new building automation system will be implemented in the building from scratch. At present 85 systems have been selected from the building's BSS. Applying more than 500 operating rules in accordance with the required functions, these systems are digitally monitored around the clock. Evaluation has revealed major operational deviations in almost all of them. Given this, the calculated carbon emissions and unnecessary operating costs are significant.

The financial services provider thus benefits from the combination of technical monitoring provided by TÜV SÜD with data preparation of all documents in a data management system provided by THÜRMER Ingenieure GmbH. The data obtained in this manner deliver the foundation for building a register of legal requirements. The register forms the basis of a digital servicing and maintenance checklist in compliance with legal requirements, which flags up any inspections due. Combination of this maintenance tool with up-to-date data from technical monitoring paves the way for the implementation of predictive maintenance. In practice, this means that, for example, air filters will only be replaced when they are dirty instead of in fixed pre-defined cycles. This will provide cleaner air in full-load operation while saving costs by reducing the system's operating time. Talks to expand the partnership to other existing buildings of the financial services provider are already under way.

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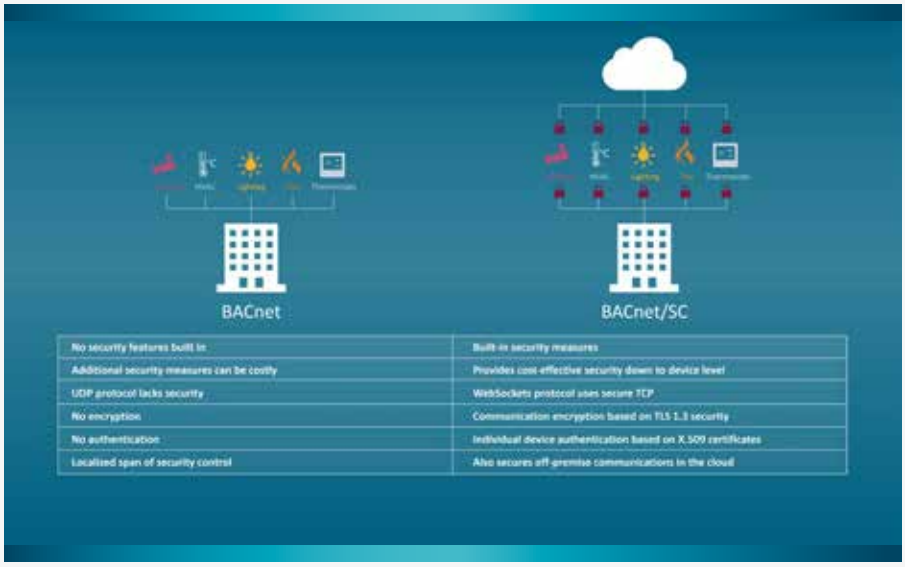
How BACnet Secure Connect Safeguards Smart Buildings in the Age of Cybersecurity

© Siemens

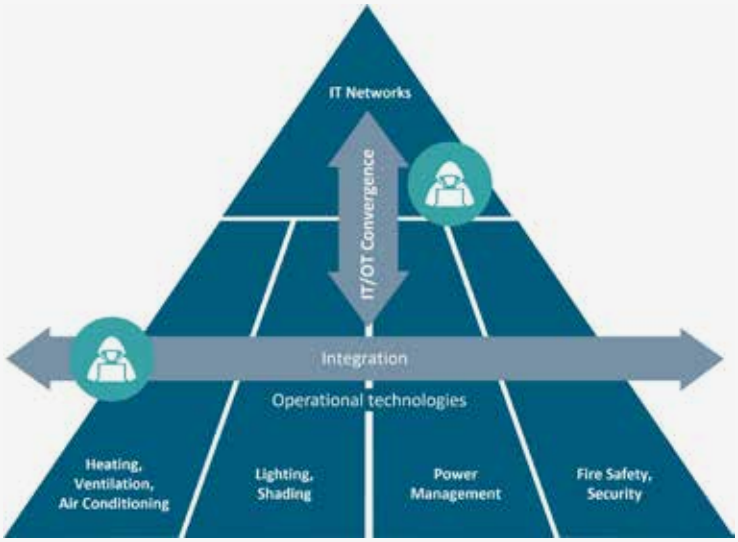
To support the building industry's digital transformation, Siemens is deeply involved in the development of BACnet/SC.

The BACnet communication protocol was a game changer when it was introduced in 1995. It functionally opened the door to greater energy efficiency and other long-awaited advances in building automation and became a globally accepted ISO-standard. However, the advent of the Internet of Things (IoT) also brought cybersecurity risks to the building automation domain. The "Secure Connect" addendum to the BACnet standard came just in time to change the cyber battleground in smart buildings.

In the early days, building automation systems were not connected to IT systems, security was not a significant concern. IoT enables buildings to connect to the Internet and, vice versa, to access and control building automation devices remotely from the Internet. Energy-, occupancy- and other business relevant data can be integrated into an organization's IT systems. This enhances functionality and satisfies CxO management's need for performance data and other KPIs. However, it also presents new challenges. With building devices communicating over the Internet and Intranet, many IT leaders fear that hackers will attack an organization through its building automation systems.



Feature comparison of BACnet and the new BACnet/SC.



Pyramide of Cybersecurity.

The impact of IoT adoption and IT-OT convergence

The widespread adoption of IoT in building enterprises was transformative, accelerating the convergence of IT and OT. While IT manages digital information flow, OT encompasses building systems like HVAC, surveillance and access control. Together, they now collect vital operational data for building owners and managers to enhance facility comfort, safety, and security. While traditional BACnet/IP devices can be easily added to any IP network, this protocol lacks the built-in network security functionality that is needed today in three security regards: no device authentication, no encrypted communication, no use of today's IT best practices. Building better security directly into the BACnet standard was a logical, but challenging, outcome.

The strength of BACnet Secure Connect

The solution to those security issues is BACnet Secure Connect (BACnet/SC), a security addendum to the BACnet protocol that was finalized in November 2019. Incorporating the same technology used to secure online banking, it addressed them in a clever way: As BACnet is a layered communication stack, the standard just added secured WebSockets as a new datalink – even with mutual TLS authentication. And it introduced a client-server working principle (called „hub-and-spoke" in the BACnet lingo) as device topology. This combines best practices from IT like TLS1.3, X.509 certificates and standard firewall setups with a high investment protection on the OT side, as all the existing building automation applications can stay unchanged.

BACnet/SC is also an evolutionary approach: Technically seen, it is „yet another datalink" to the protocol. As such, it can be handled as any other BACnet datalink before, namely by means of so-called "BACnet routers" to translate it to and from other flavors of BACnet, especially also the widespread BACnet/IP protocol. This way, BACnet/SC allows for a stepwise migration in the installed base.

To sum up, BACnet/SC has many benefits. It addresses the risks of sharing data over private and public networks while keeping BACnet systems open, flexible, and affordable. It is compatible with any previous and future versions of BACnet while applying the security techniques used by financial institutions and the IT world, addressing device authentication, encrypted end-to-end communication and deploying IT best practices. In other words, it keeps all the valuable features of BACnet/IP while providing security levels that meet the highest IT standards. When it is implemented, today's high cost to improve the security of BACnet networks will be eliminated, providing peace of mind for building owners, facility managers, and IT stakeholders alike. And due to its backward compatibility, it allows to both stepwise migration and extensions of existing BACnet/IP installations, regardless of the building size. The time to explore and adopt this emerging technology is now.

Siemens and BACnet/SC

For Siemens, the BACnet era began with the launch of a heating controller in 1995. To support the building industry's digital transformation, Siemens is deeply involved in the development of BACnet/SC and is committed to helping solve its outstanding challenges. The BACnet/SC standard is being applied to all aspects of Siemens BACnet automation systems and tools. Siemens was one of the first companies that successfully completed official tests by BACnet Testing Laboratories (BTL) and achieved BTL certificate. ■

SIEMENS

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New Cybersecurity Acceleration Program to Fast-track BACnet/SC Implementation

Cybersecurity continues to be a major concern in building automation industry resulting in more and more suppliers of these products adopting BACnet/SC as the backbone of security. Currently, there are nearly 100 BTL certified workstations and controllers available with BACnet/SC from dozens of suppliers.

BACnet/SC and your bank use the same underlying technologies to establish a secure connection. These secure connections are established by exchanging and validating certificates. This means every product intending to join a BACnet/SC network must contain valid certificates. These certificates are generated by the Certificate Authority for the BACnet/SC site. The Certificate Authority requires a unique file from the product called the Certificate Signing Request file. With this file, the Certificate Authority can generate the unique certificate files for the product.

Since a single Certificate Authority is used in a BACnet/SC system, each supplier must exchange files compatible with that Certificate Authority. The generation and processing of these compatible files will be a manual process that is time consuming and error prone.

The BACnet/SC Interoperability Acceleration Program helped suppliers jumpstart BACnet/SC product development. Similarly, the new Cybersecurity Acceleration Program will help suppliers efficiently generate, exchange, and manage these files significantly simplifying system integration.

The Cybersecurity Acceleration Program will provide a complete Certificate Authority reference implementation and a sister tool that can generate and validate Certificate Signing Request files and package them into an interoperable file format for the Certificate Authority. Additionally, all program participants will have access to cybersecurity implementation webinars and an interactive, peer-to-peer forum led by experts in BACnet and cybersecurity.

Participation in the program will help suppliers ensure their certificate management tools are interoperable with tools from other suppliers. This will keep integration costs down and maintain their reputation as a collaborative participant in multivendor environments. The program will also shorten the learning curve for manufacturers who do not have cybersecurity implementation experts on staff and help to ensure their products are ready for whatever comes next in building automation cybersecurity.

Access to BRITE (bacnetinternational.org/brite/) is also included in the Cybersecurity Acceleration Program. BRITE provides a confidential, supplier-independent environment for remote interoperability testing of BACnet devices. The focus of BRITE is BACnet/SC product interoperability testing, and it utilizes BACnet/SC to achieve secure connections over the Internet. This allows cooperating suppliers to evaluate the interoperability of their BACnet devices without physical co-location.

BRITE is built around a collection of cloud based BACnet/SC hubs along with interoperability support and diagnostic tools. Test sessions typically involve two suppliers and are arranged through BACnet International. Each session is private, only allowing access to the specific suppliers participating in that test session. BACnet/SC Interoperability Acceleration program participants are eligible for discounts and access to dedicated cloud hubs.

The Cybersecurity Acceleration Program is cost-effective, typically costing less than one week of an engineer's time. The program is $5,000 USD for Corporate Members of BACnet International and $10,600 USD, which includes a Silver Membership for non-members. The cost of the Cybersecurity Acceleration Program will increase after the program ends. For more information, visit bacnetinternational.org/cybersecurity or email david@bacnetinternational.org.

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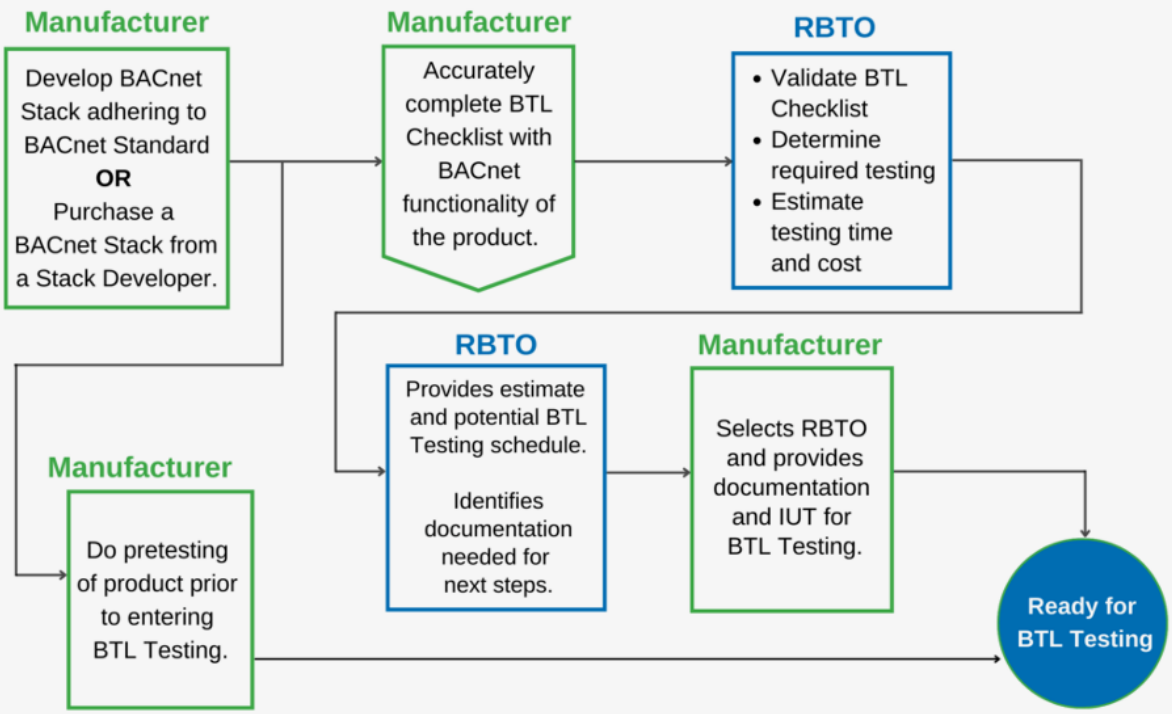
ABOUT THE AUTHOR

Michael Osborne has over 35 years' experience in various aspects of the high-tech industry. For the last 19 years, Michael has designed building automation products, managed technical projects, and supervised a team of talented developers. For most of his time in the building automation industry, Michael has also been involved in the BACnet community where he developed tests for the ASHRAE 135.1 Testing Standard and wrote proposals for the ASHRAE SSPC 135 Standard. From 2012 to 2021, Michael was the Secretary, Vice-Chair and finally Chair of the ASHRAE SSPC 135 Committee.

The Benefits of Utilizing Pre-Testing Tools



Many manufacturers and end-users are aware of the numerous benefits the BACnet Testing Laboratories (BTL) Testing and Certification programs offers. Products that are BTL Certified provide users with the confidence that a product has passed the industry standard BACnet conformance tests conducted by a Recognized BACnet Testing Organization (RBTO).

The advantages of BTL Certification can include lower integration cost, less integration risk, improved product quality and performance, and greater buyer confidence and opportunity to bid. Currently, there are over 1,300 BTL Listed products that have successfully completed testing and certification. These products can be found in the online BTL Listing Database: www.bacnetinternational.net/btl/

Before BACnet products can successfully complete BTL Certification and gain the right to use the BTL Mark, they have to pass compliance testing against the appropriate test package developed by the BTL Working Group. While getting a product tested is a worthwhile investment for manufacturers, time and cost are certainly factors that must be taken under consideration.

BTL Testing is designated for compliance rather than development. When development errors are discovered during testing, the process can be delayed, resulting in the device spending additional costly hours in the RBTOs lab. To potentially save time and money during testing, BTL strongly encourages manufacturers to take advantage of the wide-range of pre-testing tools that focus on the development of BACnet products. "It has been found that when the manufacturer performs pre-testing prior to submitting their device for BTL Testing, the issues that are found are limited, thus saving testing cost and expediting testing time," states Rich Ruel, Testing Services Manager for the BTL Lab. Additionally, the BTL Test Package, used by all RBTOs for BTL Testing, is available to developers for their own internal pre-testing.

"Besides saving time and money during conformance testing, manufacturers are required to extensively pre-test their products prior to submission to an RBTO. The RBTO is not a quality assurance lab. Products need to be ready for market when submitted," states Emily Hayes, BTL Manager.

A list of third-party pre-testing tools can be found at btl.org/pre-testing-tools. The types of pre-testing tools include Test Frameworks, BACnet Client Software, BACnet Protocol Analyzers, BACnet Device Simulators, General Tools, Reference BACnet Routers and Reference BACnet MS/TP Masters. These lists are provided as a convenience only. They represent a sampling of available resources and are not intended to be complete. No recommendation, endorsement or any form of warranty is implied or provided by BTL or BACnet International for any of the items in these lists.

For more information about pre-testing tools and additional testing resources, visit btl.org/testing-resources.

ABOUT THE AUTHOR

Mary Catherine Heard joined BACnet International in 2022 bringing a decade of marketing experience that includes website management, email marketing, social media, copywriting, and graphic design. Prior to joining BACnet International, she worked in the auto industry and state government.

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Understanding BACnet/SC for Easy IT Integration

BACnet/SC introduces important aspects to implement cybersecurity standards and to easily integrate Building Automation networks into existing IT infrastructure. With BACnet/IP, the BMS installer only needed to request IP addresses from the IT department for the BACnet/IP devices at the installation site. BACnet/SC implements the robust concepts used for secure communications over the Internet by using Transport Layer Security (TLS).

The BMS installer must be familiar with TLS communication concepts and be able explain their requirements to the IT folks for successful installation of the job site. There is also a difference between the communication architecture for BACnet/IP devices vs BACnet/SC devices. This article will attempt to familiarize the building automation installers with these concepts.

Basics of TLS (Certificates, Keys, and Certificate Authority)

TLS relies on the use of certificates and keys for data encryption, device authentication, and data integrity (i.e., no tampering). Keys occur in pairs (public/private key) and are used for encryption/decryption. A session key for communication may be generated after the initial key exchange for added security.

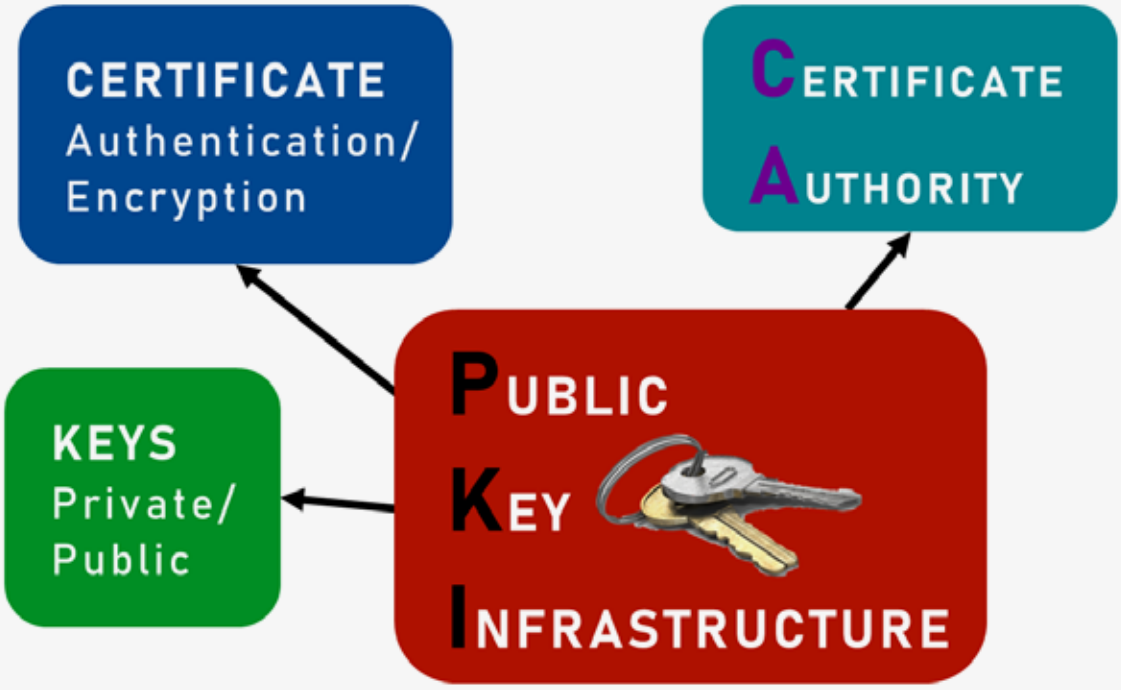
Certificates are used for authentication and encryption. The public key is part of the certificate, while the private key is secret to the device. The certificates are issued and managed by a central authority, commonly known as a Certificate Authority (CA). All devices must have certificates issued by the same CA to communicate. The device can get the certificate directly from the CA or send a Certificate Signing Request (CSR) to the CA to get the corresponding certificate.

Getting an SSL certificate (SSL is an older version of TLS) installed for a website might be a familiar concept to some people. The CA in this case is a well-known company like Verisign, Comodo, GoDaddy, Let's Encrypt, etc., that is trusted by all devices and browsers to provide access to the website seamlessly over the public internet.

For a building automation system, getting a certificate from a public CA is not necessary and can be expensive given the large number of devices in a building. The IT department can implement their own infrastructure to generate these keys and certificates. The term PKI (Public Key Infrastructure) is used to define this setup. The building automation product vendors may also have specific software tools to implement the PKI, but the certificates and keys for all devices at a site, irrespective of their brand, must be generated from the same tool to ensure interoperability. The certificates on devices also expire and need to be renewed. The validity period must be noted to ensure that the devices continue to communicate seamlessly as part of the BACnet/SC network.

BACnet/IP vs BACnet/SC

BACnet/IP and BACnet/SC both operate over the IP layer. BACnet/IP uses unencrypted communication over the UDP port, while BACnet/SC is connection-based using TCP ports for encrypted communication. BACnet/IP uses broadcast messages for the discovery process and allows any BACnet/IP device to participate in the network. A BACnet/IP device may be a server providing data with the client device requesting the data. With the open BACnet/IP architecture, a new BACnet/IP client can be added which can discover the BACnet/IP server devices and send commands to control the points on the server device.



Public Key Infrastructure to generate Keys and Certificates

BACnet/SC adds additional security to the BMS network, and each device added to the network must be authorized. This authorization is controlled by the issuance of keys and certificates. If the device is not provided with the correct credentials, then all its messages will be ignored because a successful TCP connection will not be established in the first place. BACnet/SC with TCP connections also introduces the concept of "hub" and "node" devices. Nodes (or end devices) primarily communicate with each other via the hub using directed messages, and there are no broadcast messages. Direct node-to-node communication is supported as well. To provide redundancy, a primary hub and failover hub are used in the BACnet/SC network and must be configured on the BACnet/SC devices. The number of connections supported by the hub is another consideration to allow for future expansion of the BACnet/SC network.

There may be a requirement to integrate existing BACnet/IP and BACnet MS/TP devices in the building with newer BACnet/SC devices. This can be achieved with the use of a BACnet router supporting these datalink layers, but it is recommended to keep the BACnet/SC and BACnet/IP networks separate.

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News from SSPC 135 – the BACnet Committe

On the ASHRAE Annual Conference 2023 in Tampa (from left to right): Salvatore Cataldi (Officer SSPC 135), Thomas Kurowski (President of BIG-EU), Christoph Zeller (Spokesman of the BIG-EU's Advisory Board).

The SSPC 135 and its various working groups are intensively taking care of multiple extensions and improvements to the standard.

The latest SSPC 135 plenary meeting and all the working groups took place in a hybrid format in Tampa during the ASHRAE annual conference in June 2023. This edition was notably active, marked by the ppr release of a new addendum 135-2020-cp focusing on cybersecurity. The topic holds great significance, with many stakeholders eager to see how BACnet/SC addresses it. Not only will it be possible to certify the security of the transmission channel, but also the authentication and authorization of devices.

BACnet/SC offers a method to secure communication channels between devices. To join the network, a device must possess a valid certificate. While this keeps malicious actors at bay, the mechanism treats all devices within the network equally in terms of authority. The new addendum 135-2020-cp establishes a framework that provides a means to add strong identity (authentication) and permissions (authorization) to client devices. This allows server devices to permit or deny specific operations based on this identity and permission. This way, devices can assume varying levels of authority for different tasks, and finely-grained authorization policies can be set, if needed, to limit specific operations to certain clients.

With this addendum, BACnet's authorization mechanism has two possible authorization policies. The first, termed the "centralized policy," is based on OAuth 2.0 (RFC 6749), while the second, known as the "local policy", is designed for devices that can't or don't send a token, similar to a Local Access Control List. Beyond cybersecurity, within SSPC 135, ongoing work on semantic interoperability is noteworthy. With nearly 60 participants and over 30 companies involved in the bi-weekly Tuesday meetings and subgroup sessions, this working group is actively advancing the development of the ASHRAE 223P standard proposal for HVAC system description using semantic models.

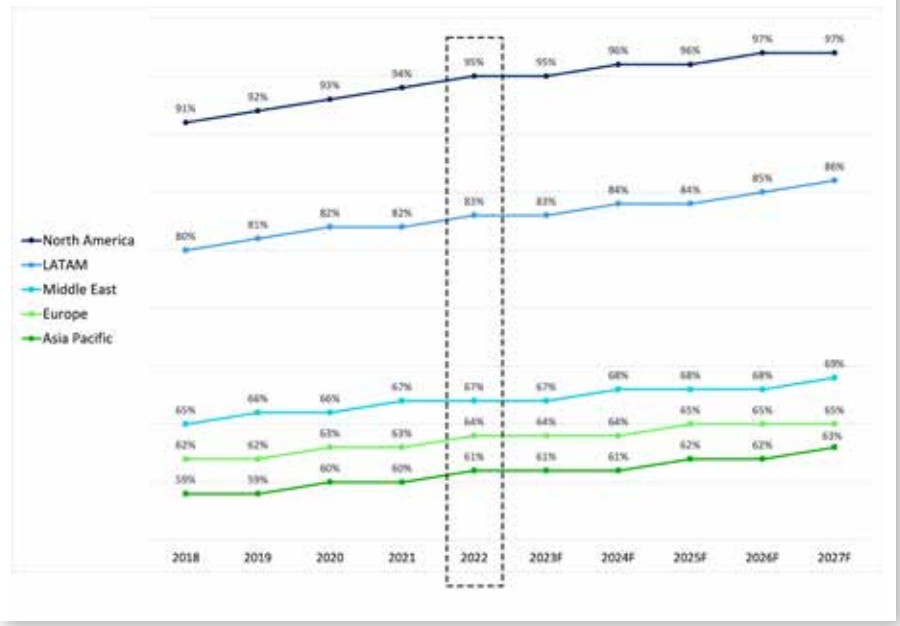
The next plenary meeting is scheduled to convene in Ft. Lauderdale, Florida, at the end of October 2023, wrapping up a successful and engaging year of developments. ■

Salvatore Cataldi
Officer of the ASHRAE SSPC 135

BACnet Protocol Expands Dominant Market Share in Latest Market Research Report

BACnet International is pleased to release the latest BACnet Market Adoption Report, drawn from the BSRIA's Market Penetration of Communications Protocols 2018 – 2027 market research study. BSRIA (www.bsria.com) is a premier provider of market intelligence in HVAC and Building Automation and Control (BACS). This study is a follow up to BSRIA's 2018 study of titled "Market Penetration of Communications Protocols". The BSRIA study draws on data from annual BACS market studies conducted by BSRIA since 2012 coupled with additional primary research. The most current BSRIA study was published in the first quarter of 2023.

BACnet Share Trend by Region, 2022 – 2027F



The latest study concludes that since 2018, the BACnet protocol continues to remain the most widely specified protocol at a global level with 77% of projects specifying BACnet, up from 64% in 2018. The five-outlook projects continued market growth with a focus on cybersecurity and BACnet Secure Connect (BACnet/SC). By 2027, the BACnet protocol is predicted to have a 97% market share in North America, 86% in Latin America, 69% in the Middle East, 65% in Europe, 63% in Asia Pacific.

This latest market research data reflects BACnet's central role in the industry as the integration platform for building automation that simultaneously achieves cost, performance, and climate impact objectives," said Andy McMillan, president of BACnet International. He continued, "The demands of that role drive continued BACnet evolution to address emerging performance and cybersecurity needs while maintaining multivendor interoperability." The BACnet Market Adoption Report was developed and initially released exclusively to Corporate Members to provide current and projected market share data in specific regions on the BACnet protocol and proprietary protocols. The report is now available to the public. In addition to testing and certification through BACnet Testing Laboratories and education through The BACnet Institute, BACnet International remains committed to facilitating the successful future use of the BACnet protocol worldwide through BACnet/SC and cybersecurity implementation programs like the Cybersecurity Acceleration Program.

ABOUT THE AUTHOR

Mary Catherine Heard joined BACnet International in 2022 bringing a decade of marketing experience that includes website management, email marketing, social media, copywriting, and graphic design. Prior to joining BACnet International, she worked in the auto industry and state government.

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Calendar of BACnet Events

Date	Location	Event	Information
2024			
03.–08.03.2024	Frankfurt, Germany	BACnet Joint Booth at Light + Building 2024	www.bacnetjournal.org/light-building-2024/lb24
13.–14.05.2024	Cork, Ireland	BIG-EU Spring Meeting 2024	BIG-EU Office, info@big-eu.org

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Issue	Topic	Focus	Registration Deadline Ads / Articles	Deadline for Submission Ads / Articles	Publication Date
BACnet Europe Journal					
40	Networking the BACnet Standard in Europe	Light + Building 2024	Jan. 12, 2024	Jan. 26, 2024	Mar. 1, 2024
41	Secure Communication with BACnet	GLT-Anwendertagung 2024	June 21, 2024	July 26, 2024	Sept. 9, 2024
BACnet France Journal					
17	BACnet Security	IBS – Intelligence Building Systems 2024, Paris	May 20, 2024	June 21, 2024	Oct. 11, 2024
Journal of Building Automation					
25	BACnet's Future in Building Automation	LightFair 2024	Feb. 16, 2024	Mar. 4, 2024	Apr. 26, 2024
26	Developments in Security and Interoperability	AHR Expo 2024	Aug. 23, 2024	Sept. 13, 2024	Oct. 25, 2024
BACnet Middle East Journal					
13	BACnet for a Smart Future	Big5 2024, Dubai	Sept. 02, 2024	Sept. 30, 2024	Nov. 11, 2024

Editorial schedule subject to change without notice.

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Editorial Notes

BACnet Middle East Journal
ISSN 2190-944X

The BACnet Middle East Journal is the Middle East magazine for building automation based on BACnet technology. Experts, practitioners and professionals show the way in applying and developing the BACnet standard – from building automation trends to devices and application projects; from qualification and training to testing and certification; from who's who in the BACnet community to useful information on events and publications.

Distribution
This Journal can be ordered free of charge by partners, members, media representatives and friends of the BACnet Interest Group. Order the BACnet Middle East Journal by email from: bacnetjournal@tema.de

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bacnetjournal.org/bacnet-journale/bacnet-europe-journal

BACnet France Journal 16 – 10/23

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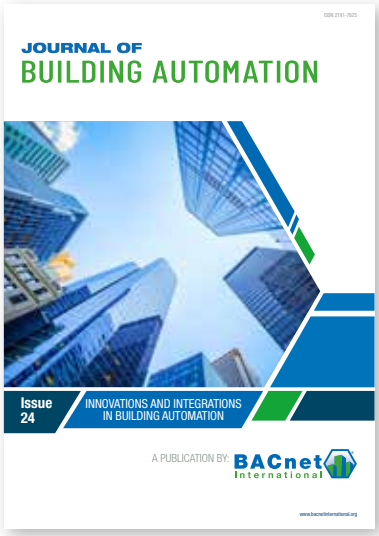

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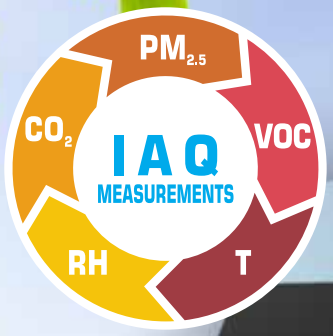

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