



By STEVEN T. BUSHBY
Mechanical Systems and
Controls Group
Building and Fire Research
Laboratory
National Institute of Standards
and Technology
Gaithersburg, Md.

To Order Call 800-323-4958
©1999 BY CAHNERS BUSINESS INFORMATION

*The BIBB addendum
should help clearly
define communication
requirements for
BACnet systems*

P

ublication of ASHRAE and ANSI's BACnet communication protocol in 1995 ushered in a new era for building automation and control systems, making it possible to integrate building control products designed by different manufacturers. This change has proved to be as profound for consulting engineers as it has been for building owners and manufacturers of building automation system (BAS) products. Despite this breakthrough, and the fact that there are hundreds of thousands of installed BACnet system control products, consulting engineers have had difficulty understanding how to write quality BACnet specifications. It has been difficult because, in many instances, specifiers have no background in computer communications and the tools provided in the 1995 standard to bridge this gap have not worked well in practice.

ASHRAE has recognized this and at its annual meeting in late June, the board of directors approved final publication of three new addenda to ANSI/ASHRAE Standard 13.5-1995. These addenda added many new capabilities to the standard, including features specifically designed to make it easier to integrate fire and life safety systems with other building automation systems. It is also a mechanism for making nonstandard extensions to BACnet network visible. For consulting engineers, *Addendum d* stands out because it was designed specifically to make the job of specifying BACnet systems easier.

Addendum d replaces Clause 2.2, Conformance and Specification, and introduces a new concept called *BACnet Interoperability Building Blocks* (BIBBs). As the name suggests, each BIBB defines a small portion of BACnet functionality needed to perform a particular task. BIBBs are combined to build the BACnet functional requirements for a device in a specification.

In developing BIBBs, ASHRAE SSPC 13.5, the committee charged with maintaining the standard, turned to a work in progress for inspiration. At the time, a separate ASHRAE committee had been developing a tutorial on BAS, now published as ASHRAE Guideline 13-2000, *Specifying Direct Digital Control Systems*. This guideline

recommends specifying direct-digital control (DDC) systems by describing the requirements in five functional areas:

- Data sharing.
- Alarm and event management.
- Scheduling.
- Trending.
- Device management.

The committee decided that it made sense to define components of BACnet functionality within these broad categories. It was decided to use small building blocks so that, for each functional area, a specifier could select from a range of capabilities that best meet the intended application of the device. Thus, the idea for BIBBs was born.

BIBBs come in pairs—designated A and B—that reflect the client/server nature of control system communication. The A BIBB represents the client or the device that is trying to obtain information or command an action. The B BIBB represents the server or the device that provides the data or carries out the commanded action. If two devices support the complimentary BACnet capabilities (the A and B side of the same BIBB), then they are interoperable from the standpoint of that function (see Table 1 page 53).

The basic idea is that for each kind of device—workstation, building controller, application-specific controller—the functional areas they need to support are selected, and then BIBBs that apply to that functional area are chosen to match the level of sophistication desired.

For example, the *data-sharing (DS) BIBBs* contain, among others, *ReadProperty (RP)*, *ReadPropertyMultiple (RPM)*, *WriteProperty (WP)* and *WritePropertyMultiple (WPM)*. The *ReadProperty* service provides a way to read a single property of a single object. The *WriteProperty* service provides a way to write to a single property of a single object. *ReadPropertyMultiple* and *WritePropertyMultiple* are more complicated in that they can read or write to multiple properties, possibly from multiple objects, in a single message. Reading or writing multiple values at one time can improve communication efficiency, but it requires more memory and processor resources and, thus, is more expensive.

USING A BIBB

To select a BIBB, the specifier must decide which level of capability is most appropriate. Consider a very simple application-specific controller. Does it have data that needs to be shared with some other device in the system? The answer is almost certainly yes. This means that it must support the B side of one of the *ReadProperty* BIBBs; some other device can read the properties of its objects. Does it have the resources to answer requests for more than one data value at a time? Let's assume the answer

is no. That means DS-RP-B is the appropriate choice. Does it need to provide a way for another device to change the value of one or more of its properties (e.g. a setpoint)? If yes, then it should also support DS-WP-B. Does it need to get data from or change values in another device? It probably doesn't, which means that it does not need any of the A side BIBBs.

The end result is a specification where these controllers must support DS-RP-A and DS-WP-B. This kind of reasoning for each application area can be used to select the building blocks that define the communication capabilities for any BACnet device.

STANDARD DEVICE PROFILES

Although the process has been simplified, it still requires considerable expertise to select **all** of the appropriate BIBBs. To help make this even easier, Addendum *d* defines a standardized version of several typical control system components:

- BACnet operator workstation.
- BACnet building controller.
- BACnet advanced application controller (B-AAC).
- BACnet application-specific controller (B-ASC).
- BACnet smart actuator.
- BACnet smart sensor.

The set of BIBBs for each of these devices is already selected and listed in a table. In order for a vendor to claim to meet the communication requirements for one of these standard net devices, all of the listed BIBBs must be supported.

The standard provides guidance about what kind of functionality can be specified for each of the standard device types, knowing that the underlying communication details are supported. This allows the engineer to focus on the application requirements instead of the communication requirements.

Now let's examine the tools themselves. A B-ASC is a device with limited resources and limited or no programmability that is intended for use in a specific application (see Table on page 54 for communication requirements). A specification that uses this profile **should** state that the controllers provided shall meet the requirements of a B-ASC. The specifier then adds specific functional requirements that fall within the range of those indicated for the device. In this case, the specification would

What Happened To Gateways?

The list of standard BACnet devices does not include a gateway. This may seem strange since many projects will need a gateway in order to connect to previously installed non-BACnet systems. Inclusion of a gateway profile was a topic of considerable debate. It was eventually decided that a gateway could be made to have the same functionality as any of the standard devices. The needs and cost constraints of a particular project should dictate how much functionality is required in the gateway. For this reason, no standard gateway was included. This is a reasonable argument, but it leaves the individual who needs to specify gateway requirements with very little guidance. BIBB requirements for a gateway, as well as recommendations for other functional requirements that should be specified, can be found under NISTIR 6397.

indicate which values are to be shared and how they are to be used. It would also indicate which values are to be modifiable and by whom.

A somewhat more complicated device is the B-AAC. This is a device that may be intended for a specific application, but it supports some degree of programmability and has a more rich set of features than B-ASC (see Table 3 on page 58 for the communication requirements). For a B-AAC, it is possible to specify more complicated application functions such as alarm generation, schedule definition and clock synchronization. The overall idea is to keep work focused on subjects for which the specifier has expertise—the requirements of building control application.

Keep in mind these standard devices are intended to be a guide. If they meet the needs of a project, use them and

continued on page 54

Table 1 - BIBBs Sampling

Data Sharing BIBBs	
US-RP-A, DS-RP-B	Data Sharing, ReadProperty
DS-RPM-A, DS-RPM-B	Data Sharing, ReadPropertyMultiple
DS-WP-A, DS-WP-B	Data Sharing, WriteProperty
DS-WPM-A, DS, WPM-B	Data Sharing, WritePropertyMultiple
Alarm and Event Management BIBBs	
AE-N-A, AE-NI-B	Alarm & Event, Notification (events internal to the device)
AE-N-A, AE-NE-B	Alarm & Event, Notification (events external to the device)
AE-ACK-A, AE-ACK-B	Alarm & Event, Acknowledgments
AE-INFO-A, AE-INFO-B	Alarm 7 Event, Information (collect or provide summary information about past events)
Scheduling BIBBs	
SCHED-A, SCHED-I-B	Scheduling actions internal to the device
SCHED-A, SCHED-E-B	Scheduling actions external to the device
Device and Network Management BIBBs	
DM-DOB-A, DM-DOB-B	Device Management, Dynamic Device Binding (find other BAC-net devices)
DM-DOB-A, DM-DOB-B	Device Management, Dynamic Object Binding (find other BAC-net objects)
DM-DCC-A, DM-DCC-B	Device Management, Device Communication Control (temporarily silence a device)
DM-TS-A, DM-TS-B	Device Management, TimeSynchronization (local time)
DM-UTC-A, DM-UTC-B	Device Management, UTCTimeSynchronization
DM-RD-A, DM-RD-B	Device Management, Reinitialize Device (remotely reset a device)

@Kavlico... Our Sensors Are The Solution!

From HVAC/R applications, Kavlico sensors and transducers provide accurate, reliable, and cost-effective measurement solutions. Featuring excellent long-term stability, high overpressure capability, EMI protection, voltage or current output, media compatible housings, and pressure ranges from $\pm 1"$ H₂O to 3000 PSI gage, absolute and differential, Kavlico sensors are an ideal fit for your HVAC/R requirement.

- VAV Control Systems
- Refrigerant Compressors
- HVAC Fan Control
- Building Pressurization
- Leak Detection Systems
- Filter Pressure Drop
- Refrigerant Recovery
- Duct Air Flow

When your HVAC/R application demands the best in sensor performance, Kavlico sensors are the solution!



14501 Los Angeles Avenue • Moorpark, CA 93021 • (805) 523-2000 • Fax (805) 523-7125
www.kavlico.com • e-mail: sales@kavlico.com

For information circle 225

Why BACnet Was So Difficult

Developing a good BACnet specification is not difficult—if you are an expert in computer communication. Here's where the 1995 standard missed the mark.

The 1995 standard did contain tools to make it easier for people with no computer communication background to select the BACnet features,

but it didn't make sense to combine all of the features into a single product. There was a need to divide the feature set into useable parts that could be selected to meet the requirements of various components of a BACnet system.

But because one size does not fit all, there was a need for options and a way to combine it into a working system. This flexibility is one of BACnet's biggest strengths

and the primary reason why it will stand the test of time. At the same time, it also makes specifying systems harder.

In attempting to come up with a better solution, several guiding principles were considered:

- Directly link the communication capabilities to application needs that are well understood,

- Provide the needed capabilities, but no more.

- Provide a path for innovation by not locking into today's approach to distributing control functionality.

The end result was a set of hierarchical conformance classes and an orthogonal grouping concept based on particular

applications such as alarm initiation or serving as a time master.

These collections of communication capabilities were called functional groups.

The idea was to select an appropriate functional group, then add functionality as represented, desired functionality. But for several reasons, it did not

The simultaneous use of two fundamentally different approaches to dividing features into specific devices resulted

categories that specifiers could neither recognize nor map to control hardware at they understood. The inherent asymmetry of the communication process was not well represented. And, perhaps most importantly, the granularity of the choices turned out to be too coarse.

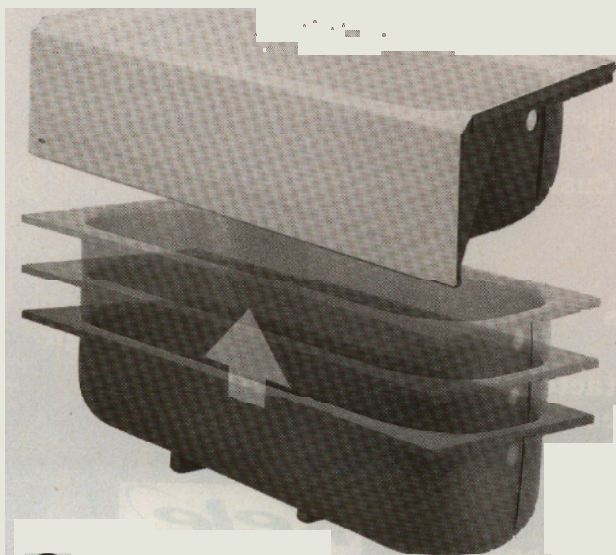
SYNIRON²^K from Bootz.

A New Generation of 5' Porcelain Bathtub

Bootz has re-engineered its popular SYNIRON bathtub and is introducing "SYNIRON²", which is the product for The New Millennium.

SYNIRON²^K combines all the features of Porcelain-on-Steel such as a sanitary finish, acid, corrosion and abrasion resistance, with a molded state-of-the-art material which is chemically bonded to the tub to ensure structural integrity.

SYNIRON²^K is lightweight and designed to reduce sound, improve heat retention and reduce damage from handling and transportation. Integral molded leveling feet make **SYNIRON²^K** easy to install.



ANSI A112.19.4M-1994 • ANSI Z124.1 Ignition Test



1400 Park Street • P.O. Box 6409 • Evansville, IN 47719

• Phone: 812 423 5401

• FAX: 812 429 2254 • <http://www.bootz.com>



For information circle 226

make life easy. But if a project has special needs for one or more devices, then go back to the complete set of BIBBs and select the ones that are most appropriate. Specification to this level of detail requires a more complete understanding of the communication details. To do it well will require more work and expertise than just relying on the standard device types.

OTHER KEY ISSUES

All of the discussion in this article applies to the application functionality of BACnet devices. But there are other issues that must be carefully specified to make a project successful over time: e.g., which network technologies to use, a naming convention for BACnet objects and a numbering convention for BACnet networks. These issues are discussed in detail in the NIST Inter-agency Report (NISTIR) 6392, which is available online under the bibliography section of www.BACnet.org. This document was prepared for the General Services Administration to help them develop high quality BACnet specifications. It includes a check-

list that can be used to determine whether or not a BACnet specification is complete. NISTIR 6392 predates the final version of *Addendum d*. It was based on a draft version of the *that* that differ from the version adopted as part of the standard.

The BACnet communication protocol standard makes it possible to integrate a wide variety of building automation and control products. The fact is, however, that engineers still struggle,

continued on page 58

Table 2 - B-ASC Requirements

Application Area	BIBBs Required	Functionality that can be specified
Data Sharing	DS-RP-B	Ability to provide the values of any of its BACnet objects upon request
	DS-WP-B	Ability to allow modification of some or all of its BACnet objects by another device
Alarm and Event Management	<i>n o n e</i>	No requirements
Scheduling	none	No requirements
Trending	none	No requirements
Device & Network Management	none	No requirements



Do You Work with Automation & Temperature Controls?

Discover Kele Service & Solutions...

A "One of a Kind" single source supplier meeting your input and output interface needs! Kele's expansive product offering captured in an inviting 700+ page catalog features a collection of sensors, transmitters, switches, gauges, transformers, actuators, relays, transducers, and more! This offering wouldn't be complete without services such as **Technical Support, Same-day Shipping, and Custom Services** packaged with a superior level of **Customer Service**.

Product Solutions

- Temperature
- Humidity
- Power Monitoring
- Pressure & Flow
- Specialty Sensors
- Output Transducers
- Lighting
- Temperature Controls

- Control Valves
- Enclosures
- Relays & Contactors
- Power Supplies & Transformers
- Installation Materials
- Lonworks
- Hazardous Locations

Services

- UL Panel Shop
- Custom Electronic Design & Manufacturing
- Custom Calibrations
- Valve Assembly



It's All Part of the Package

Phone: 901-937-4900 • Fax: 901-372-2531 • info@kele.com • www.kele.com

with the question of how to properly specify these integrated systems. Newly approved *Addendum d* is an attempt to improve the situation by defining a set of interoperability building blocks that can be used to clearly define the communication requirements of a BACnet system.

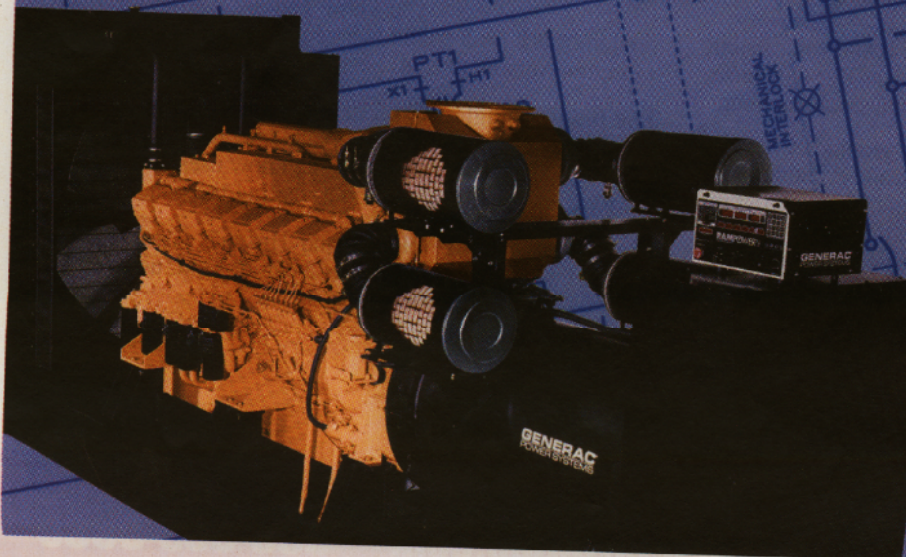
The addendum also includes several standardized building control devices for which the BIBBs have already been selected. Guidance is provided regarding the kind of application functionality that can be specified for each of these devices. The intent is to provide a reliable communication framework from which the specifying engineer can build using what they know best: the functional requirements of the application. **|cse|**

Editor's note: For a list of useful resources, visit "deep links" at CSEmag.com. Also, look for another BACnet primer in our next issue.

Table 3 - B-AAC Requirements

Application Area	BIBBs Req.	Functionality that can be specified
Data Sharing	DS-RP-B DS-RPM-B	Ability to provide the values of any of its BACnet objects upon request
	DS-WP-B DS-WPM-B	Ability to allow modification of some or all BACnet objects by another device
Alarm and Event Management	AE-N-I-B	Generation of limited alarm notifications and the ability to direct them to recipients
	AE-ACK-B	Tracking acknowledgments of alarms from human operators
	AE-INFO-B	Adjustment of alarm parameters
Scheduling	SCHED-I-B	Ability to schedule actions in the local device based on date and time
Trending	none	No requirements
Device & Network Management	DM-DDB-B	Ability to respond to queries about its status
	DM-DOB-B	Ability to respond to requests for information about any of its objects
	DM-DCC-B	Ability to respond to comm. control messages
	DM-TS-B or DM-UTC-B	Ability to synchronize internal clock upon request
	DM-RD-B	Ability to perform reinitialization upon request

Reliability Through Design



Generac Power Systems makes specifying power generation equipment easy. That's because every one of our top quality, long life products is manufactured and delivered site-ready, with an array of built-in components that other makers sell separately. With our custom SpecWriter® software, selecting the best generator set for the job is simple as well.

Best of all, Generac's broad product line — from 3 to 2000 kW — is adaptable for any kind of application, making it a high value alternative for demanding customers. With its own line of reliable transfer switches, switchgear, and controlling software, Generac is a true single source supplier of power generation.

no matter what the requirements may be.

GENERAC
POWER SYSTEMS, INC.

Changing the way you think of power.

generac.com 1-888-GENERAC