Busting BACnet® Myths

By Russ Carfagno

The purpose of building automation is to control costs and manage energy more efficiently while ensuring occupants remain comfortable. As it becomes more cost effective to move intelligence out of main control panels and into end devices such as VAV units and sensors, the amount of information generated and the degree of achievable control grows.

At the same time, integrating different systems into a single system gives even more control and provides even more information to manipulate. A risk, however, is unmanageable complexity. Building automation systems that implement the BACnet® standard are one way to reduce complexity and make building control simpler and more manageable.

While its roots are in the HVAC industry, BACnet also allows automation of all building systems, including lighting, power, security, fire and elevators. As occurs with many standards, technology, competition, and new user requirements dictate evolution or extinction. For example, when BACnet development began, the Internet was still a curiosity used mainly by universities and government. Today, the ability to communicate over a wide area using the Internet is a desirable feature in building automation.

This article looks at five myths about BACnet and how it has evolved to meet changing demands.

Myth 1: BACnet-Equipped Components Don't Communicate Effectively

Even open protocols based on published industry standards can encounter interoperability issues. Vendors may interpret the standard differently, only partially support the standard, fail to disclose the extent of support, or fall short in its actual application in the field. In the end, a vital criterion is interoperability. BACnet supporters, both at the organizational level and as individual companies, have tried to ensure BACnet compliance and interoperability in the widest range of equipment.

The BACnet Manufacturers Association, formed in 2000 to promote BACnet through interoperability and compliance testing, created the BACnet Testing Laboratory (BTL) to ensure compliance. Tested and certified equipment can carry the BTL-listed mark.

The point of compliance, of course, is to allow easy, simple interoperability among equipment—without fixes or workarounds.

Myth 2: Vendors Don't Disclose Their Properties

The object-oriented approach of BACnet allows each object to contain all the

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properties of that object. An object is contained within a device. To communicate, each device needs specific services to manage the transactions. The latest version of the standard defines 25 standard objects, as listed here.

- Accumulator
- Analog Input
- Analog Output
- Analog Value
- Averaging
- Binary Input
- Binary Output
- Binary Value
- Calendar
- Command
- Device
- Event Enrollment
- File Group
- Group
- Life-Safety Point
- Life-Safety Zone
- Loop
- Multistate Input
- Multistate Output
- Multistate Value
- Notification Class
- Program
- Pulse Converter
- Schedule
- Trend Log

In defining the properties of an object, the BACnet standard recognizes both required and optional properties. In addition, each manufacturer may add proprietary extensions to the properties or create proprietary objects to add differentiated capabilities. Problems can naturally arise when a device such as a controller does not recognize the proprietary objects or properties of an attached product.

Proprietary extensions don't have the same negative connotations as proprietary systems. In the best case, the controller simply ignores the proprietary features. Integrators can choose to use or not use BACnet extensions.

A related concern is that similar devices have similar needs for the services they use in communicating. The BACnet Interoperability Building Blocks (BIBB), defined in Annex K of the standard, introduced a new scheme for describing the interaction between two devices. BIBBs can cover such things as data sharing, alarm and event management, scheduling, trending, and device and network management.

A number of BIBBs can be combined to create a device profile that describes the interoperability for a given class of device. In other words, the profile defines a high-level device: operator workstation, advanced application controller, application-specific controllers, smart actuators, and smart sensors. The profile of an operator workstation states that the workstation will support specific enumerated BIBBs.

A second way BACnet discloses properties is through the use of Protocol Implementation Conformance Statements (PICS), through which equipment vendors clearly state all BIBBs, services, objects, and properties they have included in equipment. This disclosure will include any proprietary properties included in an object. The intent is to tell users everything they need to know about the levels of BACnet support offered by a product. A typical PICS includes the following:

- Basic information identifying the vendor and BACnet device;
- BIBBs supported by the device;
- The BACnet device profile that the device conforms to;
- All nonstandard application services supported, along with an indication of whether the device can initiate the service request, respond to a service request, or both;
- List of all supported standard and proprietary object types:
  - Any optional properties;
  - Read/write properties;
  - Whether objects can be dynamically created or deleted; and
  - Any restrictions on range of data values for properties;
- The data link layer option options supported, both real and virtual.
- Whether segmented requests are supported; and
- Whether segmented responses are supported.

PICS make it easy for specifiers and integrators to make sure the products they select have the level of interoperability they need. It will also make them aware of any proprietary extensions for which they may want to make provisions.

Myth 3: BACnet Isn't Internet-Friendly

The Internet was in its infancy when BACnet was first defined. Remote access was possible only by dial-up modem. Two fundamental successes in technology changed everything: the Internet

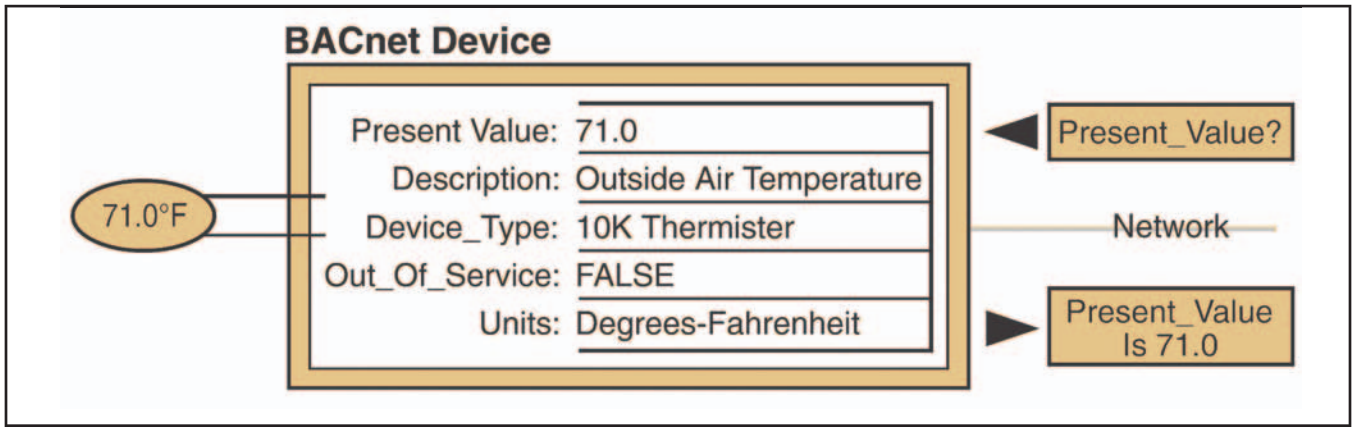

Figure 1: Analog input object.

and Ethernet. These technologies integrate communications from competing schemes to a single scheme. Ethernet is the most popular protocol for local-area networking of businesses, schools, and homes. It is gaining popularity in factory automation, building controls, and wide-area networking.

Similarly, the popularity of the Internet has made Internet protocol the preferred standard for the network and transport layers when functionality, such as Web services, is required. BACnet takes advantage of UDP/IP protocol rather than TCP/IP because of UDP's lower overhead and ability to support one-to-many messages. IP remains the *de facto* standard for addresses in internetworking applications. The world of networking is an IP-centric one.

BACnet/IP uses IP addressing on top of the Ethernet physical layer to achieve internetworking. BACnet messages can be routed across networks by a standard IP router. One drawback to using BACnet/IP is that IP is unable to handle broadcast

messages—those transmitted to many devices simultaneously—across subnets. IP routers commonly block or restrict broadcast messages to a single subnet. BACnet uses BACnet Broadcast Management Devices (BBMD) to address this need. A broadcast message is sent to a BBMD on each subnet. Each BBMD then handles the broadcast across its subnet.

BACnet can use different physical layers to achieve the most effective connectivity. While BACnet recognizes several communication methods (such as ARCNET and EIA-232), Master-Slave/Token-Passing dominates today due to its lower initial cost, with Ethernet and BACnet/IP as future contenders. A typical system might use MS/TP between VAV unit controllers as the lowest cost approach, while using BACnet/IP for communications between air-handling unit controllers and upwards to the supervisory level.

BACnet Makes Expansion Easy

A large New Jersey-based company recently constructed a 1,000 ton (3500 kW) chiller plant at its corporate headquarters. The new plant includes two centrifugal chillers with variable-speed drives, three primary chilled-water pumps, two secondary chilled-water pumps with variable-speed drives, three condenser-water pumps, two cooling towers with variable-speed drives, and four chiller isolation valves, all controlled by the chiller manufacturer's stand-alone automatic-control system that uses BACnet technology. The plant replaced a 240 ton (840 kW) absorption chiller and joins another 1,000 ton (3500 kW) chiller plant to provide comfort cooling and critical cooling to the company's office building and data center.

Because the new plant operates more efficiently than the original plant, it has replaced the original plant as the lead plant. The additional capacity provides the redundancy demanded by the company and will allow the company to meet expansion plans in the future.

The original chiller plant relies on the proprietary protocol controls of the manufacturer responsible for controlling the entire office building. By offering a controls system that incorporates BACnet's open protocol, the manufacturer was able to tie its equipment into the HVAC system already in place. As a result, both the old and the new plant chiller plants can interface and work together.

To accomplish this, the new BACnet-enabled, chiller-plant control system uses 44 system control points and 62 chiller control points, while accessing a full range of operating, safety and cycling codes from the chiller control panels.

Myth 4: BACnet Isn't Compatible With Enterprise Software

This myth relates closely to the discussion of BACnet being Internet-friendly.

Companies thrive on information to control costs, make tactical and strategic decisions, and otherwise keep a handle on the business. Building operating data is no different for controlling energy costs and maximizing comfort and productivity of users. Trends can be used for capacity planning, justification for new capital expenses, cost sharing, equipment diagnostics, and preventive maintenance. BACnet can generate lots of data about the building systems it controls. BACnet control and monitoring software can collect the data, do trend analysis, respond to events and alarms, and does a great job of automating and reporting building automation information.

However, it's not necessarily easy to integrate that data with higher-level enterprise-level software for accounting, maintenance, and management needs. Enter Web services and XML. The ASHRAE BACnet committee is working to define Web services and XML needs for BACnet.

XML, eXtensible Markup Language, provides a universal way to represent data and make it easy to use that data in various applications. Combined with SOAP (Simple Object Access Protocol), XML will make access to BACnet data easier. SOAP uses XML and HTTP to access objects, services, and servers in a platform-independent manner. HTTP, HyperText Transfer Protocol, is the primary method used to convey information on the World Wide Web. XML structures information by combining the content with an indication of what role the content plays. For example, 42 is a number, but it plays different roles if it is tagged as a temperature or a model number. Similarly, the number is different if it represents tabular data, a page number, or just a number in text.

Web services and XML are useful to obtain and organize information. They will, for example, allow a manager in New York to check the status of a building in Chicago, an accountant to run numbers on energy use, and a maintenance worker to respond to alarms—all using the same data, but adjusting it to their needs. The primary purpose of Web services is to allow connectivity between enterprise applications and the building automation system.

An additional benefit of Web services and XML is the ease with which information from different systems can be shared and used. Again, the manager in New York can control the BACnet-based building in Chicago while sharing information using an energy application with a building in Denver. XML moves information from being protocol specific to being universal.

Myth 5: LonWorks Is Preferred Over BACnet

LonWorks® is the major competitive protocol to BACnet in building automation. The two systems have been compared from cost and capabilities standpoints. And, there remains some confusion about LonWorks' openness and compatibility.

LonTalk, the physical layer of LonWorks, is an open-standard protocol, defined in ANSI/EIA/CEA 709.1. BACnet is compatible with LonTalk, and BACnet messages can be carried over

the LonTalk protocols. That does not mean, however, that BACnet and LonWorks devices can talk to one another. They can't.

LonWorks relies primarily on the Neuron chip for implementation. This steers developers to specific products. Echelon, the inventor, developer, and promoter of LonWorks, intended it as a simple, cost-effective way to build simple control networks into all sorts of structures. Many differences between BACnet and LonWorks exist. We believe two salient points give BACnet an advantage.

First, BACnet was conceived and designed for building automation. Therefore, it addresses important applications such as scheduling, trending, alarms, and programming as an integral part of the standard. With LonWorks, and its more generic roots, support of these functions was a more recent development. One advantage of LonWorks is its device profiles always have been a strong part of a LonWorks system. BACnet is catching up, however, with its own profiles, BIBBs, and PICS.

Second, BACnet is highly scalable, from a single HVAC system in one building to a campus to a comprehensive building automation system, controlling everything that can be controlled.

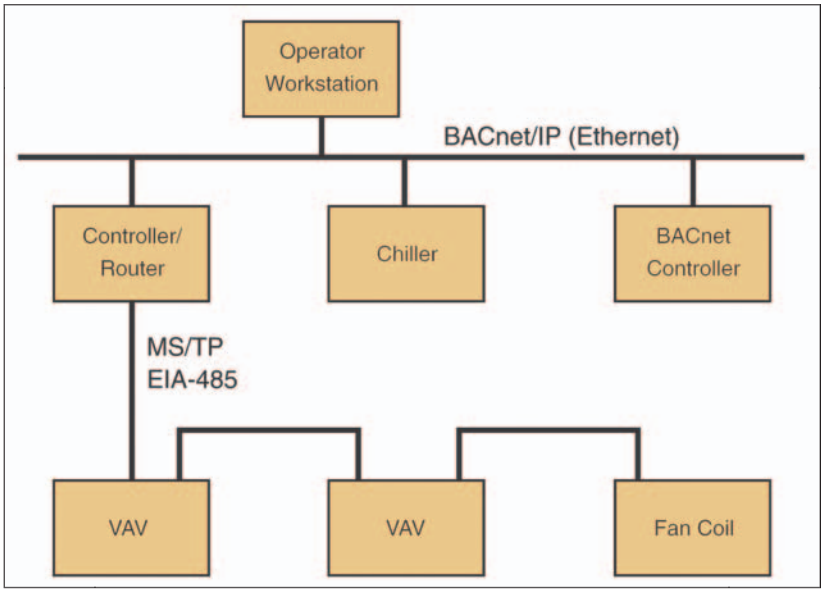

Figure 2: BACnet network using MS/TP and BACnet/IP.

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