BACnet's Success In Germany

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By Karl Leber

When the BACnet protocol was first published in 1995, the European controls and building automation market was completely dominated by controls companies with proprietary communication systems. Although customers could select from several brands of equipment at the start of a project, they tended to be locked into their choice for many years. FND (the German government's Firm Neutral (i.e., vendor-independent) Data communication protocol) and other publicly available protocols did little to alter the situation.

The newly formed ASHRAE Standard Project Committee (SPC 135P) first met in 1987 and adopted as its "charter" *the development of a set of standardized methods to achieve interoperability between and among HVAC direct digital control systems and other computerized building automation equipment*.

Fifteen years later, the results are impressive. BACnet has facilitated interoperability and provided the ability to select the best vendor for the task at hand in tens of thousands of projects worldwide.

Allianz Treptowers Berlin

German property developer GSP Städtebau Berlin decided in 1996 that the SPC's "charter" was exactly what it needed for the new Allianz Treptowers complex in Berlin. The project needed a supervisory control system that could oversee and integrate nearly 50,000 data points from systems as diverse as the European Installation Bus (EIB) lighting system, elevators, fire and burglar alarms, and HVAC. This became the first large-scale BACnet project in Germany.

Allianz, one of the world's largest insurance companies and the buildings' principal future occupant, accepted the recommendation to deploy BACnet. A U.S. BACnet expert developed the BACnet drivers needed to interface all of the connected systems. An industrial Supervisory Control and Data Acquisition (SCADA) system was installed to serve as the Building Automation System (BAS).

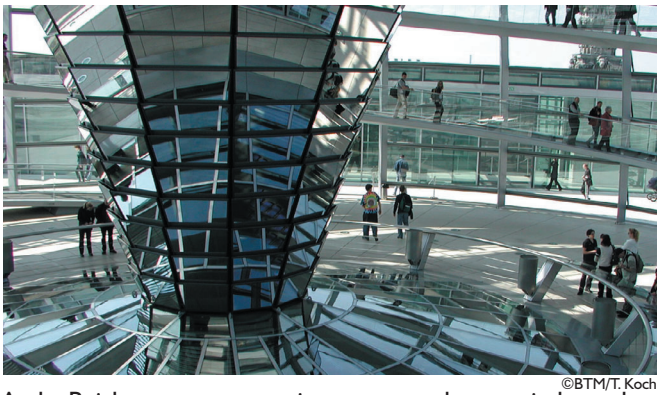
Coordination was difficult because six different contractors

installed the various automation systems of the building complex (HVAC, lighting and window louvers, fire and burglar alarms, access control, and the BAS host computers). Problems arose during the project because the vendors had little motivation to reveal the workings of their proprietary communication protocols or to provide a BACnet interface. As a result, many gateways had to be built and installed. However, none of these difficulties were attributable to BACnet itself. Allianz was sufficiently satisfied with the results that it prefers to use BACnet in all of its new projects.

BACnet was installed during a recent renovation of the Reichstag in Berlin. ©BTM/T. Koch

Having too many "players" can make multivendor projects difficult, in part because of the "not invented here" syndrome. When renovations were needed, the outsourced facility management contractors had little motivation to bring the system up to date with the latest hardware and software. As a result, many advantages of the integrated BACnet system were lost due to the use of obsolete equipment.

In one such renovation, GSP and Allianz installed a number of additional air conditioners. Allianz had learned of the success of the first major multivendor native BACnet project in the United States (450 Golden Gate in San Francisco), which brought up the possibility as to whether a native BACnet DDC system could be used to integrate the new and existing equipment. Using the same BACnet equipment as used for the majority of the Golden Gate project, the entire integration effort was accomplished in a matter of hours. This reinforced Allianz's view that BACnet should be used in future projects.



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At the Reichstag, many proprietary protocols were tied together via a BACnet/IP-Ethernet network.

Parliament Buildings Berlin

Another important project involved integrating control systems from several different manufacturers at the Parliament complex in Berlin, including the recently renovated Reichstag building. Many proprietary protocols were tied together via a BACnet/IP-Ethernet network to a proprietary BAS front end. Although the construction authorities had agreed to what was, at the time, a highly innovative design, the use of proprietary protocols and the requisite gateways resulted in a number of performance issues at both the head end and the DDC sublevels.

Allianz - Dresden

The gateway concept used in the Treptowers and Reichstag projects was copied often but BACnet was still unable to achieve a significant market share. However, property developer GSP believed that BACnet had a promising future in German projects and decided that BACnet would be used for GSP's new projects. In Dresden, another new Allianz building was designed using BACnet and the lessons learned from the Treptowers project. The building was outfitted with "native" BACnet equipment from the BAS host level to the DDC field panels and was completed satisfactorily. This was the first native BACnet project sold in Germany although, during the construction phase of Allianz Dresden, several smaller native BACnet projects were installed.

Kranzlereck and Sparkasse Dresden

BACnet was chosen for the "Kranzlereck" on the Kurfürstendamm (Berlin's stylish equivalent of New York's 5th Avenue). The developers, architect, and GSP on behalf of the Deutscher Immobilien Fond AG (another German insurance company), decided to tie together the building's automation functions via a mix of native BACnet controllers and gateways.

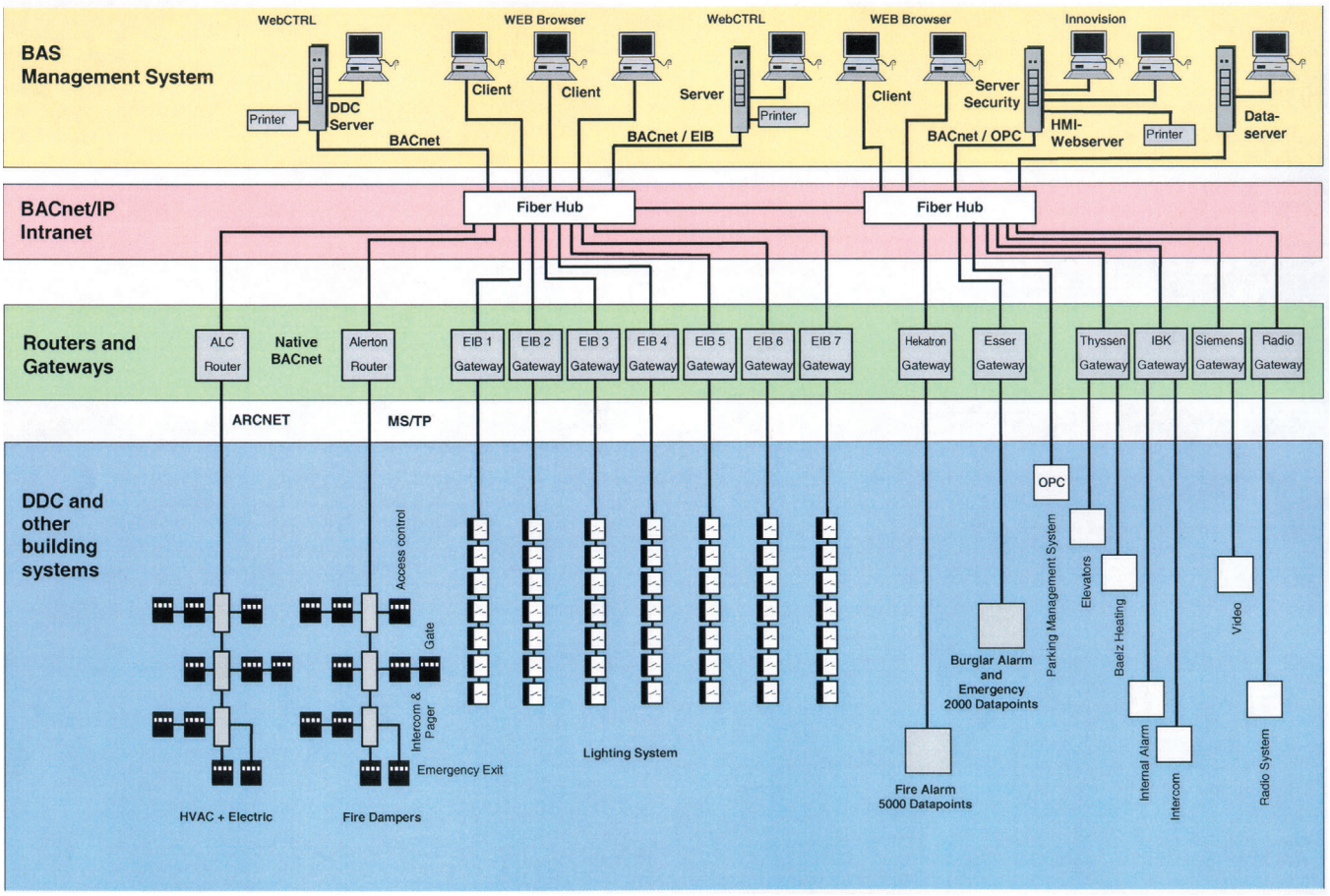

Figure 1: Schematic of the Allianz Kai Frankfurt installation. Four of the five BACnet network options were used in this project.

An industrial supervisory control and data acquisition system was used as the BAS head end. The engineering was done by an HVAC mechanical contractor, demonstrating that BACnet systems are no more complicated than any proprietary DDC system. The same contractor also carried out the complex integration of the systems in the Sparkasse Dresden project, a bank building, using BACnet. The systems included an EIB lighting system, air-conditioning package units that used the Modbus protocol, and a monochromatic plate glass system for the façade (light transmissivity can be varied via an electric signal to provide varying degrees of protection from the sun). The plate glass system was interfaced via LonTalk and the DDC system, in this case, used a proprietary protocol to a BACnet gateway.

Allianz Kai Frankfurt

Earlier this year in Frankfurt, Allianz had an extensive BACnet project with an extremely short timeframe. Allianz wanted 45,000 data points from 17 large DDC panels tied together into a functioning BAS within three months (including all installation, programming, startup and commissioning [*Figure 1*]). This task required 50 experienced DDC technicians, professional project management, and considerable skill because 15 different building systems and functions were to be integrated including:

1. Native BACnet DDC system for HVAC (5,500 data points),
2. Native BACnet DDC system for fire and smoke exhaust system (2,000 data points),
3. Modbus interface to the steam supply system,
4. EIB gateway to a lighting control system (25,000 data points),
5. CCTV system,
6. Fire alarm system (5,000 data points),
7. Burglar alarm system (2,200 data points),
8. Access control system,
9. Internal and external alarm system (1,000 data points),
10. Intercom system,
11. Parking and watchman tour system (800 data points),
12. Energy metering system via M-Bus,
13. Emergency door lock system and remote operation of gates and main entrance doors,
14. Elevator monitoring, and
15. Information and communication systems.

'Having too many "players" can make multivendor projects difficult, in part because of the "not invented here" syndrome.'

Treptowers in Berlin, Germany. ©Presse- und Informationsamt des Landes Berlin/Thie

The tight schedule precluded time-consuming custom development, so proven and readily available standard solutions were sought. Concurrently, the entire building automation/DDC/security management system had to be designed and implemented, including the required BACnet architecture, functionality and fast response time. After about two weeks, the draft design was submitted to the Allianz project managers for approval.

It was clear to the participants, that given the 12-week timeframe, a traditional contracting process was out of the question. As a result, the project was divided into a set of smaller, more manageable subprojects. These took advantage of existing control cabinets and cabling and included the EIB interface, fire alarm system, burglar alarm system, 17 DDC panels, 69 fire damper controllers, workstations for HVAC, EIB and specialized subsystems, and the security management system.

After each subproject was successfully completed, they would need to be put back together like a jigsaw puzzle. The resulting coherent system would, of course, be expected to seamlessly provide all required interoperable functions. An intranet-Web solution was well suited to this task but made it necessary to build all of the workstation graphics in a Web-capable format and the database in a JDBC-accessible (Java Database Connectivity) format, all of which required more time than usual.

Teams were assembled to deal with each subproject consisting of switchgear technicians, electricians, and control and HVAC technicians. The division of the overall project into smaller subtasks and the subsequent reassembly of the project "puzzle" demanded an innovative system configuration. Here was the biggest risk of the whole project: it would not be possible to prove the interoperability and required response time performance of the reassembled "puzzle" until about six days before the acceptance date, at which time further testing and corrections would no longer be possible.

The planned system architecture consisted of a fast Ethernet-intranet fiber optic network, several I/O servers, each with a Web server and data server for the acquisition and storage of about 40,000 data points, and Web client workstations. The required response time of 1 to 2 seconds for all security-related systems, and the slower 10 second response time for all other systems, was a lofty goal, achievable only through optimal tuning of the I/O handling and data storage processes. Since there was no time for experimentation, the team had to rely on prior experience with previously installed Web-based solutions.

As far as is known, this was the first project in Germany to take full advantage of the "multivendor" aspect of BACnet in the selection of the DDC controllers. One vendor's BACnet unitary controllers were selected for the control of the 2,000 fire dampers via a BACnet MS/TP network. A second vendor's BACnet controllers were used for roughly 4,000 HVAC data points over an ARCNET LAN. Direct Web access to all data was provided by a Web server that used BACnet/IP over Ethernet to talk to the field equipment. To use normal Web browsers as workstations, all DIN-graphics (DIN is the German national standards organization and these graphics use DIN standard symbols for system components) had to be created in a Web-accessible format.

The security management system required a two-screen system. One screen was set up to display all of the interactive building graphics along with all fire and burglar alarm points. The second screen was required to simultaneously display the current alarms with any previous alarms for the same points (including the text of any special actions to be taken or other

instructions for dealing with the alarms). At the same time, the system had to switch the alarm circuits between their "armed/disarmed/maintenance" modes and control the intercom, video and radio communication systems directly from the workstation screen in real-time. Providing these capabilities required the development of some special software to handle the bidirectional BACnet interface and database handling.

Seven of the building automation systems were successfully tied in and integrated by means of EIB-BACnet gateways. These included the lighting and motorized window shade systems; the intercom system; the fire and burglar alarm systems; and the M-Bus energy metering system. Other systems, such as the elevators, parking garage management system and municipal steam supply system were tied in either directly by means of a virtual terminal interface or via a BACnet OPC server or Modbus/BACnet interface.

Four of the five BACnet network options were used: Ethernet, ARCNET, MS/TP and PTP. The choice depended on the required performance. The choice of network architecture can have a significant impact on project costs and system performance: the most expensive, high-performance network does not always result in better overall system performance. Likewise, the more cost-effective network solutions do not necessarily result in lower performance if they are appropriately applied.

Seven building automation systems were integrated using EIB-BACnet gateways at the Frankfurt Allianz building.

Apart from the usual "Hand-Off-Auto" switches and indicators, the HVAC DDC controllers needed to be equipped with a local display for manual operation and program editing. The installed Web technology offered a cost-effective (around 3,500 Euros) and convenient solution. Simple flat panel displays were installed with built-in industrial PCs that only needed a Web browser to surf the entire DDC network and access each controller's displays, operation and program editing functions. The color displays allow access to graphics, DDC data points, and DDC programs. Alarms and trends also are available.

The entire complex building supervision and security management system was laid out as a multivendor system. All of the required functions for building automation, such as the graphical display of all the various systems and the extensive security management system, could be accessed in a completely integrated manner. Each software package was able to make full use of its "best-of-breed" functionality without limitations.

A unified workstation screen was created for the operator so that, for all practical purposes, it is impossible to tell which software package is used at any one time. Only when system or database maintenance is performed is it necessary to bypass the specific I/O or data server that is assigned to a particular automation system and access the hardware components directly. A data server provides a connection to Allianz's in-house facility management system.

Workstation navigation through the system is based on building floor plans and the specific building system with the hierarchy: "system type - building area - floor - system data point." The navigation does not require knowing to which I/O or data server a particular system has been assigned. It is possible to quickly go to any piece of equipment using a Windows® Explorer-like data tree display. User authorization is implemented with the input of a user name and password that also determines the corresponding access privileges: view - control - modify.

Conclusion

Here is a summary of the important lessons learned with BACnet in Germany:

• Highly complex and innovative building systems can be networked using the BACnet protocol. Therefore, BACnet will quickly become *the* standard protocol in Europe.

• BACnet enables shorter project times without higher costs and eliminates future dependency on a particular manufacturer.

• When diverse products and systems must be integrated, Web technologies provide significant benefits in terms of project implementation, as well as functionality and user friendliness.

• Proprietary automation and control systems no longer have a future because only open systems, with readily available documentation and support, provide users the ability to choose future products freely, whether for new construction, alterations or renovations.

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