

# The Convergence of Building Management Systems and Information Technology: Global Standards Lead to Cost Reduction and Increased Functionality

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Building Management Systems (BMS) have made tremendous strides in recent years toward embracing connectivity and interoperability standards. These efforts have given building owners more freedom to choose among manufacturers for both products and service support. Even greater benefits await an organization whose building management system is seamlessly merged with its information technology architecture. The synergy created by sharing infrastructure and data reduces operating costs and creates new service opportunities.

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## Convergence Defined

### Convergence in Building Management Systems Terms

**C**onvergence is defined as the complete integration of building management systems with the much larger information technology (IT) system and connected enterprise applications that exist within most buildings—or, on a global basis, a group of networked facilities.

An important distinction to observe is that while we have had *connectivity* between these disparate systems, we did not necessarily have *integration*. Different systems and applications can certainly communicate basic information, but they usually lack complete data-exchange capabilities. With true convergence, we are empowered to obtain more information on a by-request basis and in a manner that is more easily understood by any technology system within the building—or by the people who want to analyze the information.

This elevated level of integration opens new avenues that were not technically or economically feasible in the past; for example, sending a cell phone message to the energy manager of a healthcare campus to alert him of a potential peak in electrical usage. The information is compiled and interpreted at the building management system, travels across the IT network backbone, is sent by the enterprise e-mail server across the Internet, and delivered via the cell phone network.

In this new environment, building management systems are less expensive to install because they can use the existing IT architecture. High performance can be achieved more economically because a single high-speed network avoids the redundancy that is required with a separate building management system infrastructure. Furthermore, with fewer wires, bridges, routers and repeaters throughout a building, there is less propensity for component failure and downtime.

### Convergence as Applied to Building Management Systems

In his article entitled “Identifying the Complex Components

of Convergence,” Ken Sinclair notes that the building management system industry was a bit naive regarding Web-based systems. Many believed that simply enabling building management systems to deliver information via Web pages would magically allow that data to be among the services delivered across the enterprise for varied applications. As a result, early implementations of building management system workstations delivered across the Web often were disappointing.

While that was true in the past, now is the time for the building management system industry to seize the opportunity that convergence presents. This involves fully understanding the IT infrastructure and cooperating with those who implement the network for the enterprise. It is also important to recognize what motivates the IT department in teaming with the facility staff so that both disciplines can work together harmoniously and efficiently.

Clearly, convergence depends on the successful integration of building controls. Therefore, when a building management system device is to be added to the IT infrastructure, a document must be developed for the IT staff that describes *in their language* precisely what is being added to the shared network, and what effect the device will have on the network. The result will be a system that reflects the needs of both departments.

### Divergence

Convergence creates a wealth of new opportunities for both information systems and the people who manage those systems. Collectively, these opportunities are known as “divergence.” For example, to prevent equipment failure, facility professionals could tap the expertise of the IT department and learn their approach to maintaining network control devices. After all, they share the same network underpinning, so why shouldn’t they be similar in terms of maintenance? (No, a chiller and a data server are not alike but the networked chiller controller has a lot in common with the personal computer used to enter and access data)

Divergence, therefore, requires new skills for the building management profession. This is challenging because the skills of building managers and technical staff are an accumulation

of what they have learned over many years, as well as the limited set of solutions that were available. Now that more diverse technologies and methods are available to operate and maintain building systems, the possibilities expand.

Keeping pace with this new potential will require facility experts to broaden their knowledge base. They will need to attend different types of seminars, explore different courses of instruction and, in general, rethink the status quo. They must borrow best practices from IT professionals who have had these opportunities all along.

Building system engineers should have no fears about their profession being diminished in the future of the enterprise-connected building, says Anto Budjardjo in his article, "Convergence or divergence: which way to enterprise building management?" That's because they are domain experts who have the knowledge to design building systems so that they function properly. They simply need to realize that the landscape around them is changing and that they must adapt accordingly.

## Information Technology Standards as the Basis for Convergence

Since the 1970s, our industry has been designing building management system components as part of the mechanical and electrical systems infrastructure. Components below the workstation level all had to be rugged enough to reside in equipment rooms, yet also include some type of communications interface. Today, it is just as important for all devices that connect to the IT infrastructure to be good network citizens as it is for them to endure harsh environments. This citizenship takes many forms.

### Communications Protocols

Building management system manufacturers have accelerated the rate of open protocol device development to BACnet® or LonMark® interoperability, or both. In the new world of convergence, systems that claim to provide interoperability and conform to industry standards also must provide connectivity to a variety of equipment that integrates seamlessly into the network. Neither BACnet nor LonMark alone provide a complete answer for the vision of total enterprise information compatibility. A better solution is to apply the new standards for interoperability, such as XML-based communications applications, in order to achieve all of the benefits that each protocol offers individually. In general, systems that require interoperability on a broad basis will be best served if they support multiple protocols. It is always a good practice to keep interoperability options open.

To many, it is beyond their experience base to be concerned about network management considerations. This is where the strict adherence to IT standards is critical to the success of convergence. One by one, we can review these standard network protocols and languages.

**eXtensible Markup Language (XML)** is the universal language of Internet data exchange, and can be called across platforms and operating systems regardless of programming language. XML is the basis for a new form of systems interoperability that relies on Web Services. These are small, reusable applications that handle all communication between otherwise disparate devices or applications.

**Simple Network Management Protocol (SNMP)** compatibility is a must for building management system devices, as it allows the IT department to use their network management software to check the status and operation of all network connected equipment. SNMP-enabled supervisory engines can report alarms or warnings based upon memory usage, processor temperature, or other critical operating attributes of the hardware or software.

**Simple Network Time Protocol (SNTP)** provides the standard method of synchronizing time between a designated time server and all of the building management system devices. Historical data functions and scheduling elements are impacted by this function. Imagine the difficulty in scheduling energy usage in a school or office without synchronizing to the rest of the network.

**Simple Mail Transfer Protocol (SMTP)** support is also required so that messages from supervisory devices can be transmitted using standard e-mail. This feature is important because the use of Internet client devices for operation, as opposed to workstations, means that alarm reporting software may not always be online. Pagers and e-mail must substitute for dedicated alarm annunciation. A caution here is that many virus attacks are carried by incoming e-mail. System designers must take care if receiving messages is required.

**Simple Object Access Protocol (SOAP)** is the most common transport mechanism for XML. SOAP rides on the Ethernet IP network.

**HyperText Transfer Protocol (HTTP)** is the vehicle for most Web browser-based communications, and also requires the Ethernet IP network for building management system implementation.

There are more protocols and languages that may be utilized within a networked environment, but the common thread throughout this convergence discussion is that you don't want to be saddled with a proprietary solution where a standard exists.

Security is another major concern in this world of hackers, virus attacks and even spam. It is important to have system

components that leverage the efforts of the IT department in terms of security. At a minimum, this means that building management system devices must behave in the presence of anti-virus software and accept an authentication scheme that is compatible with the network. It is also important for the building management system servers and network-connected controllers (engines) to operate through firewalls in an efficient and secure manner. Most IT departments are hesitant to open additional ports for these systems.

## Operating Systems

Standard operating systems are essential in a converged environment. Manufacturers must give up their proprietary, industry-specific operating systems and embrace IT computing standards. This is necessary to set a firm foundation for the other IT standards that will support enterprise applications integration and project development tools. These are needed to better deliver the benefits and efficiencies of integrated operation. Quite simply, BMS suppliers do not add value by creating and maintaining their own operating systems.

There is no magic solution here, but it is obvious that Microsoft has the most universal set of operating systems applied to the largest set of end devices on a global basis. Is it possible to apply Linux or Sun Solaris or Mac OS to the same tasks? Yes, with a clear recognition of what tasks must be accomplished and which devices these tasks and applications will be applied to.

## Web Server Technology

In virtually all cases, it is desirable to use an organization's standard Internet browser as the user interface for a building management system. A Web solution that still requires a dedicated workstation (sometimes disguised as a server) is not delivering on the vision of networked computing. This requires a change in the basic network architecture, which is shown in Figure 1.

The building level supervisory controller must be replaced with an IT-enhanced engine because there is no workstation in the new system's architecture. Therefore, the supervisory controller must accept additional responsibility as a user interface, a data server, and as a programming tool repository. To accomplish these tasks is not difficult, but it can be challenging to accomplish them in a manner that gives users easy access to enterprise computing applications. Also, to provide easy to learn and use tools for the programming and commissioning of such devices is an even greater task. Systems that require integration professionals or advanced users to write HTML pages in order to access information meet the *intent* of convergence, but do not deliver the features and functions required to satisfy end-user needs.

As a rule of thumb, make everything accessible to the Internet or corporate intranet as much as possible, while keeping security needs in mind. Use the latest and best networking and server technology, and make sure that the system communications are standards-compliant in every possible way.

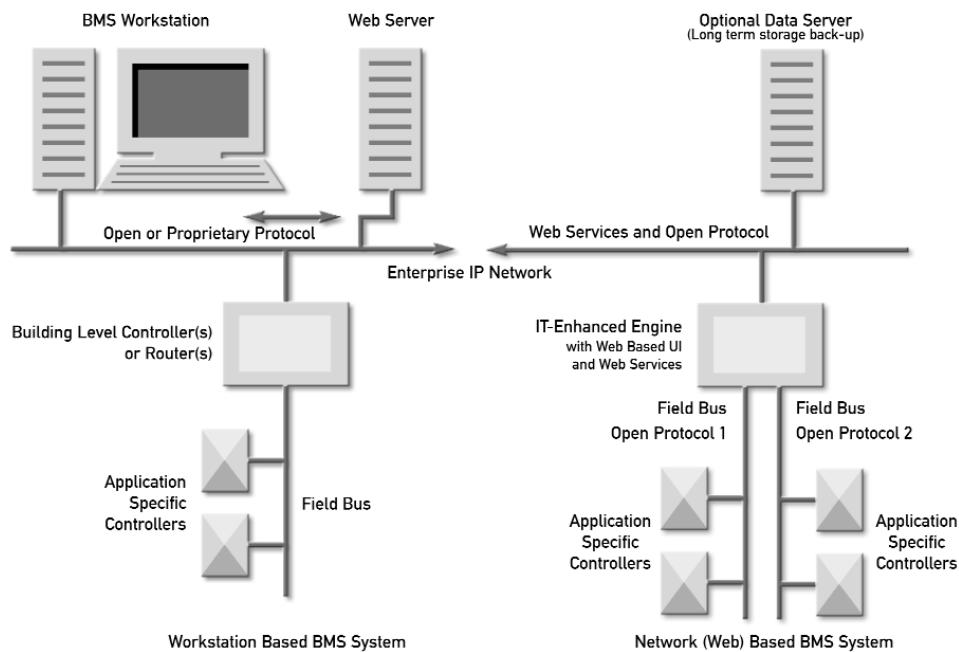


Figure 1  
**Workstation Based vs. Network Based Systems**

## Hardware

By changing the requirements for communications and infrastructure compatibility, the hardware that is employed must change fundamentally. The following table highlights the methods and equipment that building management system developers have employed in the past, along with today's requirements and, in the right hand column, the vision for the future that needs to be supported. All new hardware must support this functionality and drop seamlessly into the IT network used by the enterprise.

| <i>Legacy Systems</i>    | <i>Today's Systems</i>     | <i>Technology Vision</i>    |
|--------------------------|----------------------------|-----------------------------|
| Workstation-based UI     | Client/server-based UI     | Networked computing         |
| Supervisory controllers  | IT-enhanced engines        | Power at the core           |
| Proprietary OS           | Standard/open OS           | Enterprise IT compatibility |
| Proprietary protocols    | Open/standard protocols    | Device interoperability     |
| Proprietary data storage | Open/standard data storage | Data interoperability       |
| Mechanical/electrical    | IT infrastructure          | Information ubiquity        |

## Building Management System Applications

### Equipment Monitoring

There are two fundamental reasons to monitor equipment. One is to alert the operator in the event of a failure or potential failure; the other is to gather data to evaluate maintenance and operational effectiveness. Because a converged system is more capable of communicating with more devices and exchanging data with other applications across the enterprise, both of these functions can be improved and expanded.

### Environmental and Energy Reporting

Just as equipment monitoring provides information vital to operating the equipment being monitored, it is necessary for the environmental and energy consumption information within a single building or campus to be effectively communicated.

In the past, there was often a disconnect between the data collected by the building management system and the information required by an owner's representative to effectively model and control energy usage. The ability to access and communicate both real-time and historical data between energy-using end devices and environmental monitoring devices (the building management system)—and enterprise computing applications—had not kept pace with other IT developments.

Convergence provides the pipeline to deliver this information anywhere, anytime by using Web technologies as the delivery mechanism and avoiding the use of dedicated workstations that confine users to a chair in a control room or office.

## Alarm Transmission

The purpose of an alarm is notification. If an alarm sounds in an unmanned control room with nobody to hear it, then no alarming function is being performed. In this era of mobile work environments and multiple task assignments, it is important for alarms to track the intended recipient. Reference was made earlier to an alarm interfacing with the IT network and ultimately being communicated via cell phone. The application of network communications capabilities in a converged environment expands this capability to include pagers, wireless laptops, PDAs and other multimedia-enhanced personal devices. We now have the ability to communicate and share vital information with individuals or groups of individuals across the globe. And those same individuals can find a computer terminal or Wi-Fi hot spot to get additional information about an alarm that they have received.

### Database Sharing

Until now, we have had databases that were purpose-built for building management systems or industrial control systems. It was not easy to merge this information into databases that reside elsewhere in an organization. However, if data is stored in a standard Oracle or Microsoft SQL database structure, it can easily be exchanged throughout the enterprise.

For example, we may use our energy consumption database to estimate next month's energy bill, merge this information from our financial database into enterprise databases so that other departments can more accurately forecast their budgets, and print a report that identifies the resultant enterprise expenditures.

### Equipment Time Sharing

When all building systems are truly interconnected and can speak the same language, it is possible for computers and devices to serve multiple purposes. For example, a television camera can be used for more than just security. That same camera also can monitor a device that indicates whether a sump is high or low. A small box in the corner of the sump will have a raised flag if a problem in the unit needs attention. Monitoring this via the security camera eliminates the need for visual inspection, thus increasing employee productivity.

Occupancy sensors that turn lights on could be synchronized with the security system. The same could be true for air quality, by pumping the right amount of fresh air into a building at the right time. We could also determine whether a particular area within a facility is using too much energy based on the occupancy.

## Remote Access

As noted in the section on alarm transmission, we live in a mobile world. We don't want to be tied to a single location to do our jobs, much less a chair in front of a computer. Global professionals require access to information without contacting another person or traveling to a fixed location. The current Web infrastructure in first- and second-tier countries throughout the world provides just such a connection, as long as the system is converged with it at the source. Connecting a computer to the Web with a cell phone, wireless access of a PDA to the network in a hotel, or simply walking into the Internet café on a cruise ship gives anyone access to this capability. Care must be taken by systems providers to ensure a capable and straightforward user interface to leverage these capabilities.

## Future Opportunities

### Web Services and Interoperability

The convergence of building control and IT infrastructures will pay its biggest dividends in what is called "Web Services." Web Services are a way of sharing information between computers and between software applications that is based on XML.

The Web Services model provides information to diverse requestors of information. This opens the floodgates for a new class of information-rich applications to be delivered anywhere, anytime across a network that is in place and inexpensive. In most discussions on the subject, it is accepted that initial delivery of these services will be accomplished over the Internet or corporate Intranets via a combination of XML and SOAP (Simple Object Access Protocol). XML defines the pages we look at and is a common model for data representation, while SOAP is used for client-to-server communication.

The immediate goal for our industry leaders is to define services and objects that the XML/SOAP communications standards can request and deliver regardless of the originating systems or the protocols inherent to their basic operation. This will answer a common question: Will it be necessary for all systems in an enterprise to use the same building management system protocol to provide information to the client? The answer is no. As long as each system can handle the data and respond to the request for information, it doesn't matter how the information got there. BACnet, LonMark, MODBUS or any proprietary protocol are all equal service providers in the eyes of an XML/SOAP-empowered client. Web Services will not be a substitute for interoperability at the control level, or the accuracy and dependability of individual controllers.

What we will have is a fully Web-enabled system that bridges the gap between the controls and IT infrastructure within an enterprise. It will deliver information-rich, data-based applications that are transportable between standard hardware and software platforms. It will be expandable and extendable using both protocols and hardware that are proven in our industry.

The ability to use Web Services as a tool for the analysis, control and prediction of energy usage is greatly enhanced by a standard means of defining the XML data so that building management system and energy-consuming device vendors all conform. This simplifies the task of integrating this information.

The array of services that can be provided is a powerful motivator toward implementation. Here are just a few:

- Energy accounting services allow each building to report data to a common repository.
- Air quality services enable indoor air quality from large, multi-site locations to be analyzed in light of geographic and meteorological factors.
- Services that compare the efficiency of mechanical and electrical equipment to benchmarks.

Web Services are just beginning to have an impact in leveraging this convergence. In the future, a college professor who wants to use energy and air quality data in a case study will be able to do so easily. Today, the professor may be hesitant to ask for information that would require many hours for the college facilities staff to extract.

### Wireless Communications

A fast-emerging concept in buildings today is the wireless distribution system. The basic infrastructure is a system of cables, antennas and other components engineered to capture and convey signals throughout the building, and confine them to the interior. When added to the wired infrastructure, they can help building occupants tap the full power of today's and tomorrow's wireless services and applications.

The goal is to employ an in-building wireless distribution system that provides complete wireless coverage for a full range of voice and data services. Once a wireless distribution system is installed, it can be modified and expanded without intrusive, costly infrastructure changes. A well-engineered system helps eliminate dead signal spots and facilitates the expanding number of wireless applications and devices. These include wireless LANs, personal communications services (PCS), cell phones, PDAs, pagers and two-way radios for maintenance and security.

Such a system also enables wireless building automation in conjunction with a state-of-the-art building management system. The wireless infrastructure will help the building

management system access data from multiple enterprise applications and assimilate the data into meaningful information that helps busy managers operate more efficiently.

This technology will help customers seamlessly and cost effectively integrate fire and security systems and other building controls, whether they are in one building or spread across a corporate campus. As momentum builds, wireless distribution technology will become an integral part of a facility's infrastructure, providing building owners with solutions that simplify operations, reduce costs and improve efficiencies.

For example, a new Chicago area children's hospital plans to use the technology to improve access to patient medical information through PDAs or other handheld devices. A doctor can check a patient's vital signs without reporting to the bedside. Hospital employees can read e-mail without having to stop at their desks. These are just two of the many productivity enhancements that a wireless distribution system offers.

## Closing Thoughts

In a perfect world, an organization's building management system and information technology architecture are a seamless entity. They work in concert because they share resources and adhere to the same set of standards. This ideal scenario offers many benefits, including:

- Reduced management and infrastructure equipment costs.
- Critical building system information is readily available at all levels of the enterprise.

- Employees can access and act upon this information without the constraints of a dedicated workstation at a fixed location.
- New services are possible that save time and preserve resources.

When making an investment in building management system technology, an organization should look beyond today's configuration. Decision-makers need to cast a wider net and recognize the advantages of merging the building management system into the IT infrastructure. Whatever technology platform is selected to harness energy and operational data, it must be fully compatible with the IT network that is already in place. Allow the building management system to rely on the IT network as the data highway for safe and reliable transportation of information. In return, the IT staff will provide critical services for planning and maintenance.

This is the future. Or the present, for the two are drawing closer.

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