White Paper

Baja: A Java[TM] - based Architecture Standard for the Building Automation Industry

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Open Systems And Interoperability In Building Control

Building control systems can make environments more comfortable, safe and efficient by integrating systems such as heating, air conditioning, lighting, security and telecommunications into one centrally controlled, automated system. In order to do this effectively different systems need to be able to communicate and interact with each other.

The Promise

By integrating these control systems with intelligent software applications, buildings can become active structures that receive signals from diverse controlling and monitoring devices and then send those signals to the appropriate appliances and systems in the building. The result would be a building management system that allows administrators to do everything from setting lighting and air conditioning schedules to controlling energy usage via a standard web browser – *or better yet does it for the user automatically.*

The Issues

Two issues have held the industry back from achieving this promise. One is the prevalence of different communications protocols currently embedded in automation devices. The other is a lack of software. As we will see these issues are related.

Software in the automation industry has not advanced at the rate in which that in the mainstream computer industry has. It is far more expensive and is not as mature. These issues are compounded by the fact that the software currently in use was not developed on an architecture that allows seamless use of the Internet and browser technology.

The Background

Unlike the computer industry there has not been a foundation or framework for independent software developers to build on in the automation industry. All software applications, by necessity, come from the supplier of the automation hardware. By comparison, the PC architecture and Microsoft Windows operating system in the

mainstream computer market created a universal framework. This allowed developers to build software with universal application across a wide range of products and markets. Think what it would be like if your word processing application only worked on Dell computers (or Compaq or HP). This was the case with office computer systems like those from Digital Equipment and Wang before the PC revolution . History has shown that this is not a supportable paradigm. The PC revolution erased proprietary solutions from the map. More importantly, it erased the proprietary segmentation from the computer industry. Software became a tool that could be used across different manufacturers' computers. The result was an unimaginable explosion of software and computer technology and a revolution in the way that business uses technology.

Why Has Building Automation Been Different?

So why has the building automation industry been immune to similar progress?

Protocols

First, the building automation industry is permeated with many different communication protocols. The major reason for this is related to growth of the building automation industry before the PC revolution. Available technology at the time required manufacturers to build highly proprietary solutions. There were no standard fieldbus network solutions or software object standards. In fact, the proprietary solutions manufacturers created used to be the competitive advantage of a company – they had created a solution where none existed.

Today the proprietary nature of these systems has become a ball and chain for everyone. Manufacturers spend the majority of R&D dollars building communications infrastructure over and over again for each new product line they develop while trying to maintain limited compatibility with their legacy systems. Consumers are forced to accept software with features and functionality that are severely outdated compared to the other applications they have on their desks.
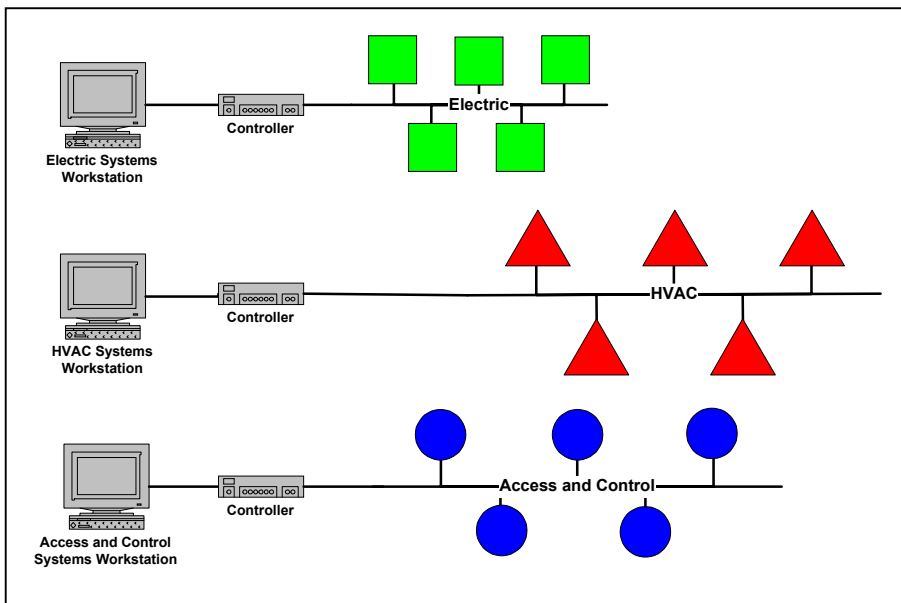
The Economics Of Legacy Systems

Unlike the mainstream computer industry, where we update computers every three to four years, investments in embedded systems are expected to last for as much as 15 years. This is partly due to engineering and installation costs, which can account for as much as 90 percent of the end user costs for the system – embedded devices themselves represent only 10 percent of the overall cost.

Because today's competing systems are so proprietary, changeover to a new system means replacing the legacy system and involves enormous re-engineering and installation costs. The result is a "Catch 22" – economics don't support upgrades to a new system. Even though the new systems are better, they are still proprietary.
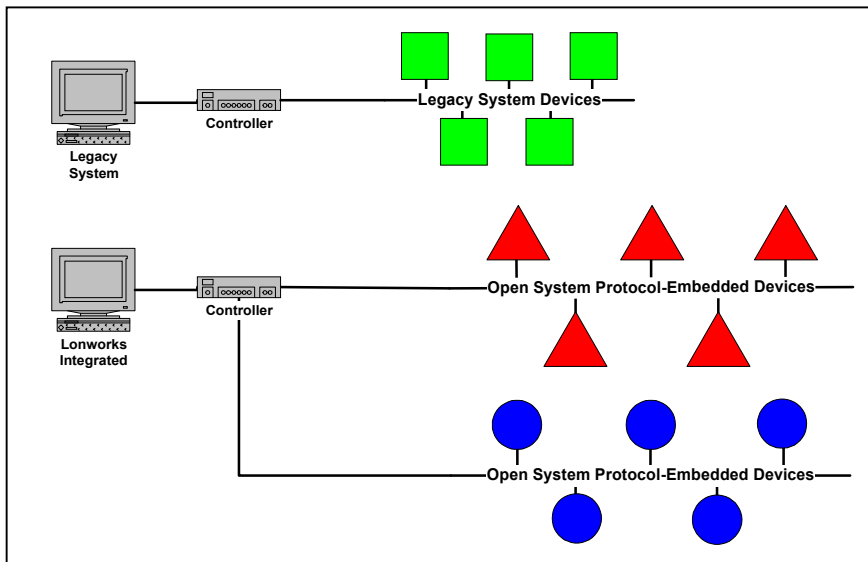
Today's Attempts

Until recently, truly integrated building control systems were extremely difficult to create. Devices made by different manufacturers were unable to communicate with each other, much less allow users to access and integrate the data they provided. (See Fig.1) The trend in the building control industry has been to attempt to solve the integration problem through the use of limited open or "standard" communication protocols, which would allow users to integrate systems regardless of their manufacturer.

Figure 1: In non-integrated systems, separate items on the fieldbus, such as HVAC and Electric, required different control centers and different software for operation.

Too Many Protocols, But No <u>One</u> To Talk To.

At present, the movement to this completely open environment for building automation still has hurdles to overcome. Several initiatives to create standard communication protocols in building control devices (such as LonWorks® and BACnet®) have created opportunities for constructing open system environments. But these protocols, which are focused at the embedded device level, only provide interoperability when all of the devices (e.g., controllers for air conditioning units or security systems) are based on the specific communication protocol. (See Fig. 2) So while interoperability is achievable, it is segmented by the technology of the underlying hardware – this is not a solution for the consumer.

Figure 2: In limited open systems, system integrators have the ability to operate multiple heterogeneous devices, provided they have the same embedded open system protocols. However, the software for these systems do not integrate.

These emerging open system protocols have seen some success as an option for newly constructed buildings as long as system designers insure that all installed systems come from manufacturers who have embedded the chosen protocol in their hardware. New buildings, however, account for less than one percent of the market.

Older buildings, which account for a majority of the market, come with the previously mentioned legacy issues, which are very complex. Consequently, administrators choose to maintain their legacy systems rather than replace them, and are forced to work with the limited individual applications provided with these legacy systems.

The Solution:

In order to break this cycle, the automation industry needs a standard framework and software architecture which:

- allows independent software developers to develop applications that can be used across a wide variety of systems, including competing systems from different manufacturers and different types of similar systems.
- embraces the emerging standard fieldbus protocols (BACnet, LonWorks, EIB, etc.) while at the same time giving full support to the existing legacy systems.
- is built from the ground up on Internet standards.

While this type of framework provides communications with different protocols, both emerging standards and legacy protocols, this is just the footing of the foundation. The most important step happens after the communications part of the puzzle is solved.

Standard Object Model

The framework creates an abstraction layer that takes all of the raw data from the diverse field systems found in buildings, and "morphs" it into a standard software object model that supports all types of devices and provides standard API's for interacting with the devices and their data. This allows software developers full access to all of the information and commands available in the target systems, enabling them to develop software applications that work for all of the systems that have been brought into the framework.

The movement to software based on object standards has profoundly affected the way developers create applications. The Internet has spawned a wealth of reusable software components and consequently a multitude of standard frameworks, which are being used to leverage these components. Most notably, Java™-based frameworks are beginning to provide suites of application components, or APIs, for the development of Web-based business applications.

Just as the standards movement of the Internet made it uneconomical for software developers to build their own protocol stacks, Java frameworks are making it uneconomical for developers to create all of the software components necessary to tie business logic into transactional databases and Web servers. Baja does this for automation systems.

Baja <u>Is</u> This Standard

Developed by Tridium Inc. over the last 4 years, and based on continuous input from building automation manufacturers, systems integrators and industry professionals, this technology is now being opened up for industry-wide use through the Java Community Process as the Baja Standard – Building Automation Java Architecture. Baja provides a vendor neutral, Internet-enabled, object-based framework for automation systems.

Anytime, Anywhere Access

Baja addresses interoperability issues and at the same time takes us to the next step in the evolutionary process by moving this new open environment to the Internet. There is little question that the Internet is driving change at an unprecedented rate. The catalyst behind this is based on a suite of open standards for networking and data encoding that includes TCP/IP, HTTP, HTML, POP3, SMTP and XML. Widespread acceptance of these standards has created a consistent Internet infrastructure, which has allowed us to network the entire world. This has also positioned Web browsers as the universal client for deploying and retrieving information, thus obsolescing the need for proprietary user interface software. Baja makes building automation systems fully compatible with the Internet infrastructure.

The Opportunity To Move Forward

In order for the building automation industry to reap the benefits of the Internet, and bypass the limits and proprietary segmentation of the past, a standards movement, much like the one experienced by the Internet, must occur. Only then, will the merger of open system protocols and Internet access give administrators the opportunity to establish fully Internet-enabled, real-time access to the automation and control of their buildings,

regardless of the manufacturer, platform or operating system being used. Without open system standards for the building control industry, system integration and Internet access for most will not be options.

Baja (Building Automation Java Architecture) is a standards effort with the mission of creating an open Java platform for the building automation market. As an architecture, Baja is a suite of component software applications designed from day one to take advantage of the power of the Internet, supporting true plug-and-play, multi-vendor interoperability. With the framework and API standards, Baja allows development teams to focus on the unique qualities of their applications and the value they present to the user. The result is a solution that unlocks the potential of smart devices and the Internet in ways previously unimaginable, while providing significantly lower automation and information infrastructure costs.
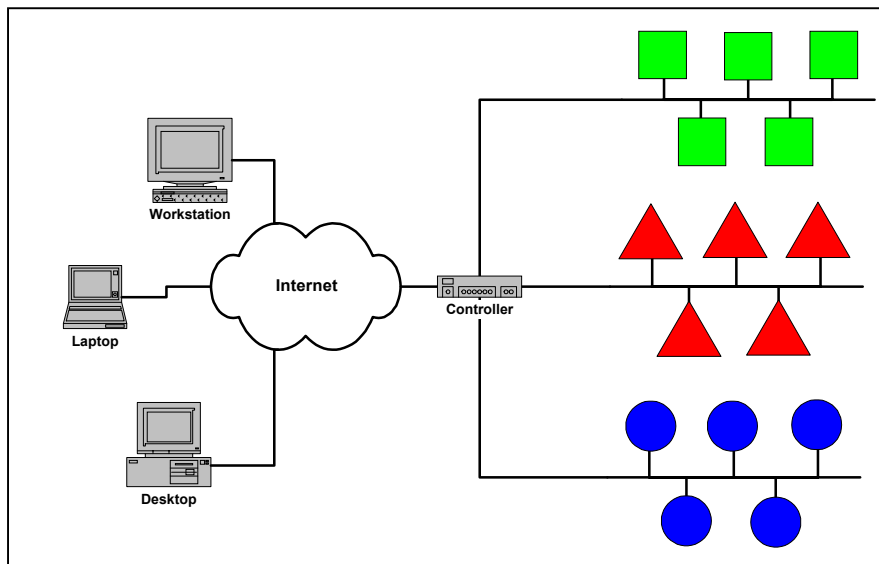
The expert group shepherding Baja through the standards process consists of many of the major players in the automation industry. These include:

- Tridium, Inc.
- Sun Microsystems
- Invensys
- Honeywell
- Siemens Building Technologies
- Johnson Controls
- Yamatake
- Echelon
- CPC (Emerson Electric)
- The Trane Company

Baja has the potential to define the building automation application environment with specifications that describe a set of Java APIs and XML schemas for interoperable control system applications. This standard is driven by the unique requirements of the building automation industry. It defines a standard Java architecture for programmable controllers, a common component architecture that enables interoperability between multi-vendor software and heterogeneous devices, a model that is easily used by non-programmers to construct control applications, and the ability to program while the application is running.

The Baja specification provides an opportunity to usher in a new standard for building automation systems. One that creates an independent open framework which will allow product vendors and service providers to concentrate on their value-add solutions rather than the underpinning technologies. The result of following a Baja standard for the building automation industry will be to create an environment that allows integration of all devices regardless of their manufacturer or their communication protocols.

For the 99 percent of existing buildings in the U.S. market that currently cannot afford to replace their devices to meet open system standards, this means freedom from hardware-lock-in and software lock-in. Baja will give System integrators the power to easily develop their own applications and device drivers in a user-friendly, open environment. They will be able to communicate with and integrate information from all the systems and software applications that run their buildings to meet their customers unique needs with best of breed solutions and complete Internet compatibility. (See Fig. 3)

Figure 3: With Baja compliant systems, systems integrators have the ability to integrate homogeneous devices as well as the software running them. And because of the Baja architectures Java-based platform, management of these systems can be accessed from anywhere users can find an Internet or network connection.

The Evolution Has Begun

The Baja Java Architecture Standard is set to change the building automation industry forever. For the first time, developers will have a framework to develop software

applications that not only allow multi-vendor interoperability, but also complete Internet compatibility.

Systems integrators will be able to dramatically modernize building automation systems, manufacturers will be able to offer best-of-breed products to previously inaccessible customers, and those customers will have the freedom to choose the best systems for their buildings. And in such an open environment, administrators will have complete control over all information and the management of their integrated systems.

The evolution to Baja is here.